

NL

END
DATE
FILMED
4-8
DTIC

LEVEL *II*

(13)

AD A 095798

M-X

ENVIRONMENTAL
TECHNICAL REPORT

ETR 25
CEMENT

DTIC
ELECTE
S MAR 3 1981 D
D

DOC FILE COPY

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM									
1. REPORT NUMBER 13) AFSC/ETR-81-40	2. GOVT ACCESSION NO. AD-A093798	3. RECIPIENT'S CATALOG NUMBER									
4. TITLE (and Subtitle) M-X Environmental Technical Report, Environmental Characteristics of Alternative Designated Deployment Areas, Cement Industry.		5. TYPE OF REPORT & PERIOD COVERED 9) Final Report.									
		6. PERFORMING ORG. REPORT NUMBER MX ETR 25									
7. AUTHOR(s) 14) M-X-ET-25		8. CONTRACT OR GRANT NUMBER(s) F04704-78-C-0029									
9. PERFORMING ORGANIZATION NAME AND ADDRESS Henningson, Durham and Richardson Santa Barbara CA 93010		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 64312F									
11. CONTROLLING OFFICE NAME AND ADDRESS Ballistic Missile Office Norton AFB CA		12. REPORT DATE 22 December 1980									
		13. NUMBER OF PAGES 12) 80									
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified									
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE									
16. DISTRIBUTION STATEMENT (of this Report) Unclassified/Unlimited											
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)											
18. SUPPLEMENTARY NOTES											
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <table border="0"> <tr> <td>MX</td> <td>Cement</td> <td>Texas</td> </tr> <tr> <td>Siting Analysis</td> <td>Nevada</td> <td>New Mexico</td> </tr> <tr> <td>Environmental Report</td> <td>Utah</td> <td></td> </tr> </table>			MX	Cement	Texas	Siting Analysis	Nevada	New Mexico	Environmental Report	Utah	
MX	Cement	Texas									
Siting Analysis	Nevada	New Mexico									
Environmental Report	Utah										
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Cement industry effects were frequently mentioned during scoping for the M-X Deployment Area Selections and Land Withdrawal/Acquisition EIS. M-X related construction will require large quantities of cement for construction of facilities such as protective structures, operating bases, and runways as well as for simulated indirect development such as housing and commercial facilities. This study documents model to predict relative price effects with and without M-X construction in the regions.											

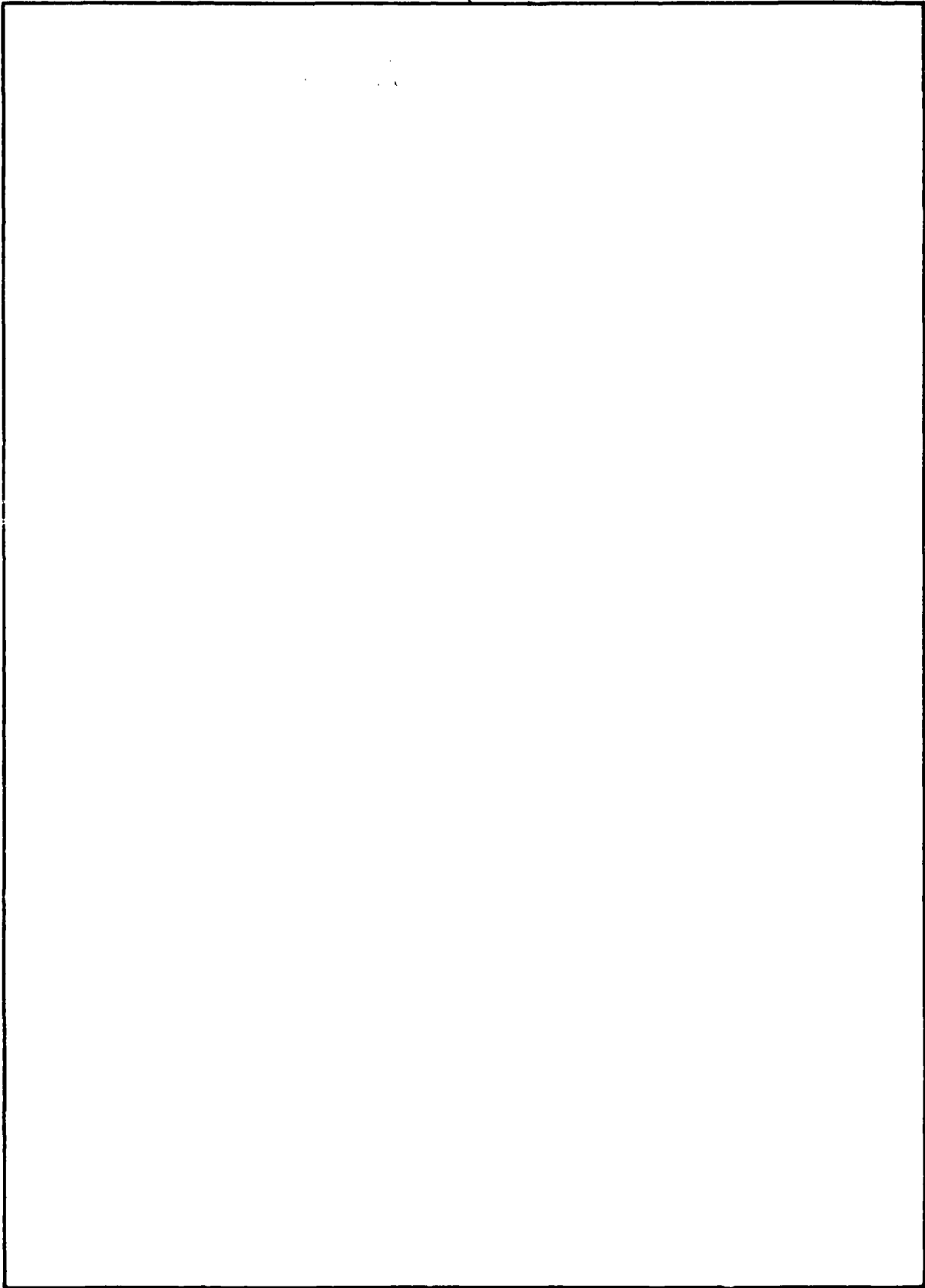
DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified 4 17 17 17

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

**ENVIRONMENTAL CHARACTERISTICS
OF ALTERNATIVE DESIGNATED
DEPLOYMENT AREAS:
CEMENT INDUSTRY**

Prepared for

United States Air Force
Ballistic Missile Office
Norton Air Force Base
California

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

By

HDR Sciences
Santa Barbara, California

22 December 1980

**DTIC
SELECTE**
S MAR 3 1981 **D**
D

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

TABLE OF CONTENTS

	<u>PAGE</u>
1.0 Cement Industry Baseline Information	3
1.1 The United States Cement Industry	3
1.2 The Cement Industry in the Nevada/Utah Market Area	18
1.3 The Cement Industry in the Texas/New Mexico Market Area	29
2.0 Price Impacts on Cement Associated with the Construction of the M-X System	49
2.1 Forecasting Techniques and Predictive Model	49
2.2 Production and Consumption Projections for the Nevada/Utah Market Area	57
2.3 Production and Consumption Projections for the Texas/New Mexico Market Area	57
2.4 Projections of Price Impacts	57
2.4.1 Full Deployment in Nevada/Utah	57
2.4.2 Full Deployment in Texas/New Mexico	60
2.4.3 Split Deployment	63
3.0 Conclusion	65

LIST OF FIGURES

	<u>PAGE</u>
1.1-1 Cement shipments	6
1.1-2 Cement use by construction categories	7
1.1-3 Comparison of total construction put in place with cement consumption	8
1.1-4 Comparison of industrial-commercial construction with cement consumption	9
1.1-5 Comparison of residential construction with cement consumption	9
1.1-6 Comparison of public building construction with cement consumption	10
1.1-7 Comparison of nonbuilding construction with cement consumption	10
1.1-8 Cement prices in the United States: 1960-1978	12
1.1-9 Trend in mode of transportation for cement shipments	13
1.2-1 Nevada/Utah; Texas/New Mexico average mill value of portland cement	27
1.2-2 Cement plants in the geographical market for cement, Nevada/Utah	32
1.3-1 Nevada/Utah; Texas/New Mexico average mill value of portland cement	42
1.3-2 Cement plants in the geographical market for cement, Texas/New Mexico	45

LIST OF TABLES

	<u>PAGE</u>
1.1-1 Characteristics of the cement industry	4
1.1-2 United States cement industry capacity utilization rates	15
1.1-3 United States cement company capacities	16
1.1-4 United States cement plant capacities by states	17
1.2-1 Nevada/Utah market area production of portland cement by district	19
1.2-2 Nevada/Utah market area consumption of portland cement	20
1.2-3 Nevada/Utah market area consumption growth rates	23
1.2-4 Nevada/Utah market area portland cement shipments by type of customers	24
1.2-5 Nevada/Utah market area average value of portland cement shipped by district origin	26
1.2-6 Nevada/Utah market area cement plant capacity by states	28
1.2-7 Nevada/Utah market area by plant capacity	30
1.2-8 Nevada/Utah market area announced cement/clinker capacity changes	33
1.2-9 Portland cement capacity utilization, Nevada/Utah market area	34
1.3-1 Texas/New Mexico market area production of portland cement by district	35
1.3-2 Texas/New Mexico market area consumption of portland cement	37
1.3-3 Texas/New Mexico market area consumption growth rates	38
1.3-4 Texas/New Mexico market area portland cement shipments by type of customers	39
1.3-5 Texas/New Mexico market area average value of portland cement shipped by district origin	41
1.3-6 Texas/New Mexico cement plant capacity by state	43
1.3-7 Texas/New Mexico market area by plant capacity	44
1.3-8 Texas/New Mexico market area announced cement/clinker capacity changes	47

	<u>PAGE</u>
1.3-9 Portland cement capacity utilization, Texas/New Mexico market area	48
2.1-1 Nevada/Utah market area estimated coefficients and "T" statistics	51
2.1-2 Texas/New Mexico market area estimated coefficients and "T" statistics	53
2.1-3 Projections of independent variables	56
2.2-1 Nevada/Utah market area forecasts	58
2.3-1 Texas/New Mexico market area forecasts, 1980-1989	59
2.4.1-1 Impact on cement prices associated with construction of the M-X system in Nevada/Utah, 1980-1989	61
2.4.2-1 Impact on cement prices associated with construction of the M-X system in Texas/New Mexico, 1980-1989	62
2.4.3-1 Impact on cement prices associated with the split-basing of the M-X system	64
3-1 1987 peak year requirements as a percentage of production, capacity, and expected capacity, Nevada/Utah market area	66
3-2 1987 peak year requirements as a percentage of production, capacity and expected capacity under split-basing	67
3-3 1987 peak year requirements as a percentage of production, capacity and expected capacity, Texas/New Mexico market area	68
3-4 Consumption and capacity projections for Utah	71

ACKNOWLEDGEMENT AND CAVEAT

This report was prepared from material developed by Frank K. Stuart and Associates, Salt Lake City, Utah, under contract to HDR Sciences, Santa Barbara, California. The report was prepared to provide baseline data and to develop a predictive model for price effects. The M-X project requirements incorporated into the report represented the best data available at the time the work was performed. The baseline data and the predictive model are approximate for use with any revised set of project requirements data.

CEMENT INDUSTRY

Cement industry effects were frequently mentioned during scoping for the M-X Deployment Area Selections and Land Withdrawal/Acquisition EIS. M-X-related construction will require large quantities of cement for construction of facilities such as protective structures, operating bases, and runways as well as for stimulated indirect development such as housing and commercial facilities. This study documents models to predict relative price effects with and without M-X construction in the regions.

1.0 CEMENT INDUSTRY BASELINE INFORMATION

This section of the study presents an overview of the cement industry within the United States, setting forth the historical demand, production, capacity, and prices that have existed in the cement industry in the past. Following this will be sections providing descriptions of the industry in the market areas of Nevada/Utah and Texas/New Mexico.

1.1 THE UNITED STATES CEMENT INDUSTRY

The cement industry within the United States is very homogeneous and generally the producers within the industry are single product manufacturers. Cement products are few although one particular product, gray portland cement, is very dominant (Council on Wage and Price Stability, 1977).

"Portland" is not a brand name but a generic term used to designate any hydraulic cement or a cement product that hardens in the presence of water. For practical purposes, all cement used in construction is portland cement. Portland cement accounts for over 95 percent of all cement products consumed within the United States. Other types of cement include (1) "white cements" used for architecture such as stucco and terrazzo; (2) "blended cements", a combination of portland cement and other cementitious materials; and (3) "masonry cement". The latter types of cement generally account for less than 5 percent of the annual cement consumption within the United States (Portland Cement Association, 1978).

Historical data relating to the cement industry from 1960 through 1978 are set forth in Table 1.1-1.

The production of cement increased from 62.8 million tons in 1960 to 85.5 million in 1978, an overall increase of 36.1 percent. Although the production of cement has shown a general upward trend, annual production has shown substantial variation.

From 1960 through 1973, cement production grew at an annual compounded growth rate of approximately 2.6 percent. This should not suggest that the past growth be characterized as a smooth upward trend. Production, especially during the 1966-1973 period, has been somewhat erratic.

Although cement production from 1960 through 1973 exhibited some annual variation, the variance was not significant. Cement production hit an all time high in 1973, reaching 87.6 million tons; however, the boom was short-lived. The cement industry was severely impacted by the recession which characterized the United States in 1974 and 1975. In 1974 production dropped to 82.9 million tons, approximately 4.7 million tons less than the 1973 level. The recession hit the nation's cement industry the hardest in 1975 when production dropped to approximately 69.7 million tons, 13 million tons less than 1974, and approximately 20 percent less than the 1973 production level.

With the recovery period that followed, cement production resumed its upward growth. Production reached 74.5 and 80.1 million tons in 1976 and 1977, respectively. In 1978 production reached 85.5 million tons, the second highest production level throughout the 1960-1978 period.

Table 1.1-1. Characteristics of the cement industry,
1960-1978.

YEAR	SHIPMENTS ^{1,2}	PRODUCTION ¹	IMPORTS	EXPORTS	INVENTORY ¹	PRICE* (DOLLARS PER SHORT TON)
	(THOUSANDS OF SHORT TONS)					
	(1)	(2)	(3)	(4)	(5)	(6)
1960	61,492	62,817	772	35	6,704	\$17.95
1961	63,050	63,662	681	54	6,846	17.80
1962	65,258	66,163	1,059	71	7,332	17.61
1963	68,666	69,260	758	86	7,425	17.17
1964	72,054	72,453	683	134	7,475	17.12
1965	73,637	73,103	1,035	141	6,193	16.90
1966	74,722	75,533	1,328	201	7,651	16.74
1967	73,371	72,539	1,112	184	7,907	16.87
1968	77,980	77,507	1,370	177	7,892	16.95
1969	80,319	78,375	1,921	111	7,129	17.20
1970	76,385	76,116	2,597	139	6,574	17.88
1971	82,297	80,317	3,088	125	6,425	19.01
1972	85,282	84,556	4,911	101	7,035	20.59
1973	90,727	87,573	6,686	325	5,557	22.23
1974	82,914	82,888	5,732	290	7,510	26.79
1975	70,684	69,721	3,702	494	6,923	31.41
1976	75,226	74,495	3,107	466	7,185	34.25
1977	81,614	80,060	4,038	239	6,074	36.76
1978	87,999	85,481	6,577	55	5,351	41.17

3988

*Data cover portland and masonry cement for the 50 states and Puerto Rico, and include cement produced from imported clinker.

¹Includes imported cement shipped by domestic producers.

²From 1973 to percent annual data also covers Puerto Rico.

*Annual data are average f.o.b. plant and are from the Bureau of Mines annual canvass.

Source: Bureau of Mines, Minerals and Materials, A Monthly Survey, January 1980.

Cement shipments show the same type of variation as production. Although the variation is similar, the growth in shipments has outpaced the growth in production. In 1960 shipments totaled 62.5 million tons compared to 90.7 million in 1973, thus representing an overall increase of 47.5 percent compared to an increase of 36.1 percent in production over the same time period. On an annual compounded basis, the growth in shipments from 1960 through 1973 averaged approximately 3.0 percent compared to a 2.6 percent average growth rate for production (see Figure 1.1-1).

Similar to the trend in production, the recession of 1974 and 1975 resulted in declining shipments of cement in the United States. Cement shipments dropped from the previous high of 90.7 million tons in 1973 to 82.9 million tons in 1974. Shipments continued their downward trend in 1975, declining to 70.7 million tons. Only in the period preceding 1965 had shipments of cement reached as low a point as it had in 1975.

With the recovery that followed the 1974-1975 recession, cement shipments resumed an upward growth. Shipments totaled 75.2 million tons in 1976 and increased to 81.6 million tons in 1977. Shipments continued to increase, reaching 88.0 million tons in 1978, an increase of approximately 26 percent over the recessionary demand exhibited in 1975.

Almost all portland cement shipments are in bulk, with the basic unit of measure the 2,000 pound ton. Bulk shipments account for 92 percent of cement sales and 94 pound bags comprise the remaining 8 percent (Portland Cement Association, 1978).

Cement use by customer category is illustrated in Figure 1.1-2. Ready-mixed concrete producers comprise on the average almost two-thirds of all cement consumption. Other large consumers are (1) concrete products manufacturers, (2) highway contractors, and (3) building material dealers.

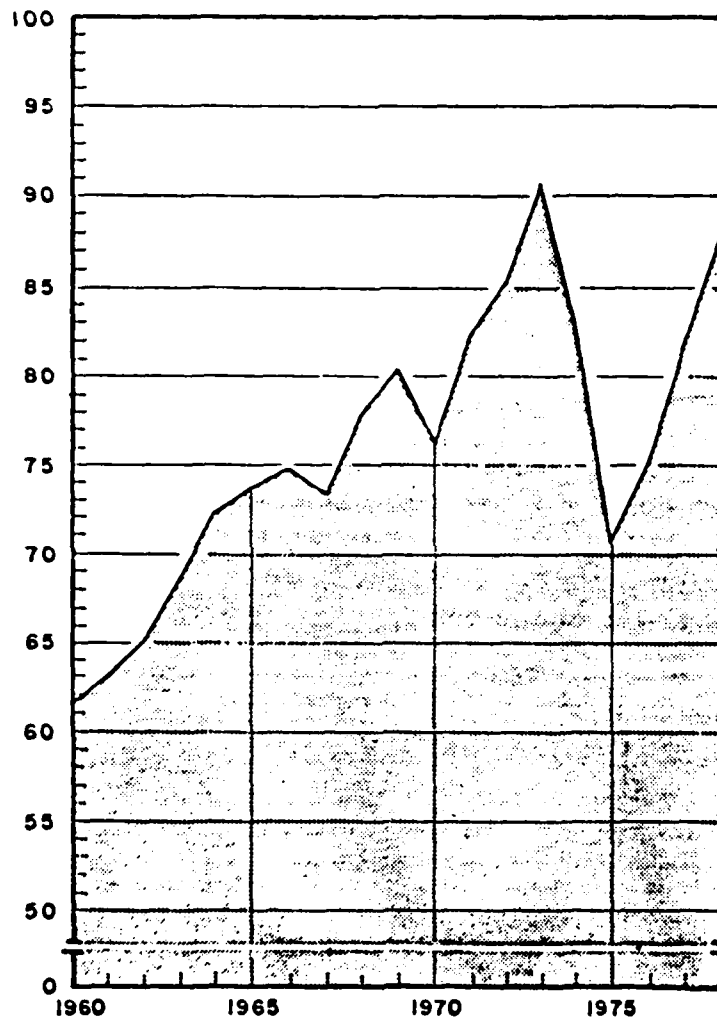
The consumption of cement has historically paralleled the volume of construction. Figure 1.1-3 sets forth the above relationship. Although some variation exists, the variation is generally attributable to changes in the construction mix from cement intensive construction projects such as highway paving to less intensive projects like grading and drainage projects (Portland Cement Association, 1978).

Although the consumption of cement is closely related to total construction, no single construction category can be considered a key indicator of cement use. Many analysts believe that cement consumption in the short run is sensitive to changes in residential construction, which accounts for 25 to 30 percent of total cement use (Portland Cement Association, 1978).

The relationship between cement use and several construction categories is depicted graphically in Figures 1.1-4 through 1.1-7. The illustrations indicate the difficulty in forecasting cement use on the basis of expected growth in any single construction category.

Imports of cement into the United States have shown a rapid increase. In 1960 imported cement totaled 772,000 tons and comprised only 1.3 percent of the industry's total shipments. In 1978 imports totaled 6,577,000 tons and accounted for

THOUSANDS OF
SHORT TONS



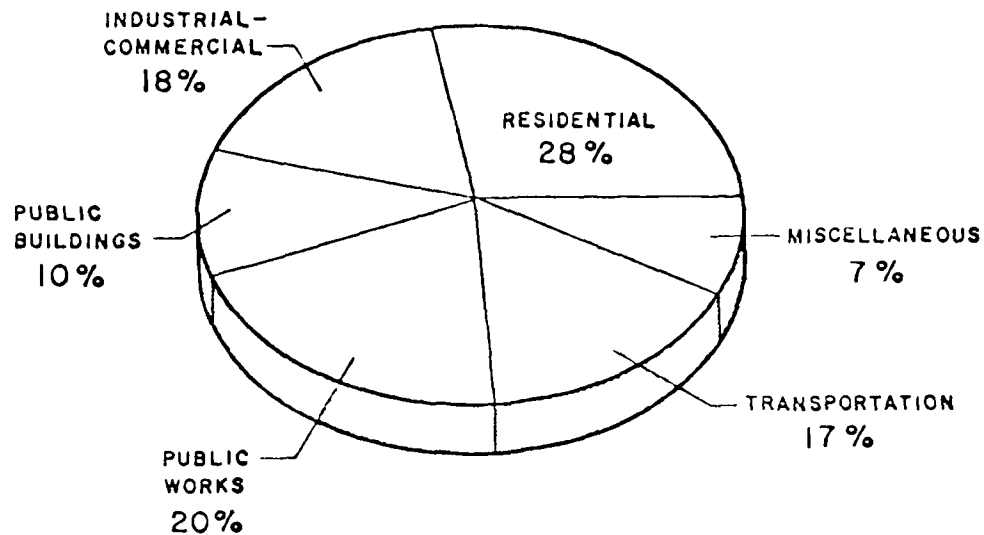
SOURCE: BUREAU OF MINES, MINERALS AND MATERIALS, A
MONTHLY SURVEY, JAN. 1980.

3729-A

Figure 1.1-1. Cement shipments,
1960-1978.

CEMENT USE BY CONSTRUCTION CATEGORIES

(FIVE-YEAR AVERAGE, 1972-76)



CEMENT USE BY CUSTOMER CATEGORIES

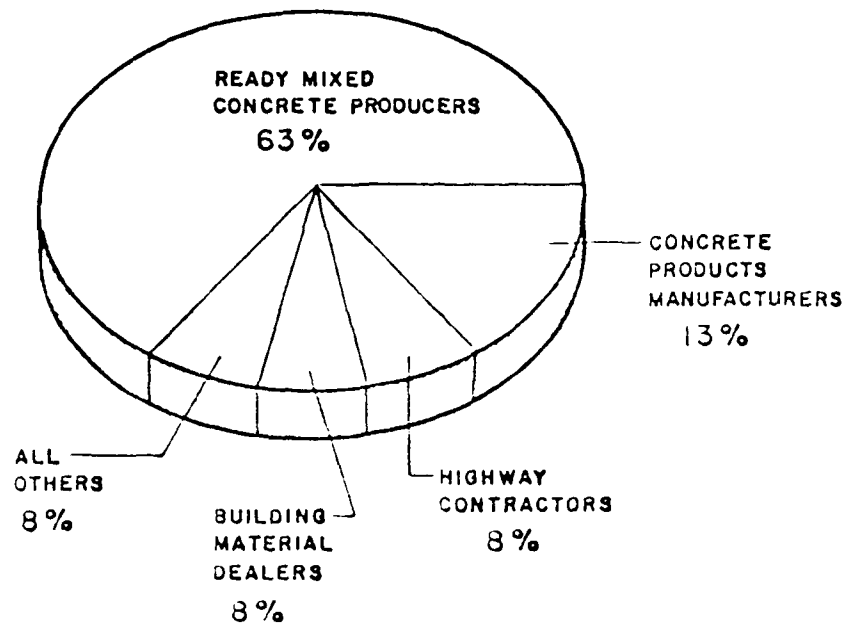
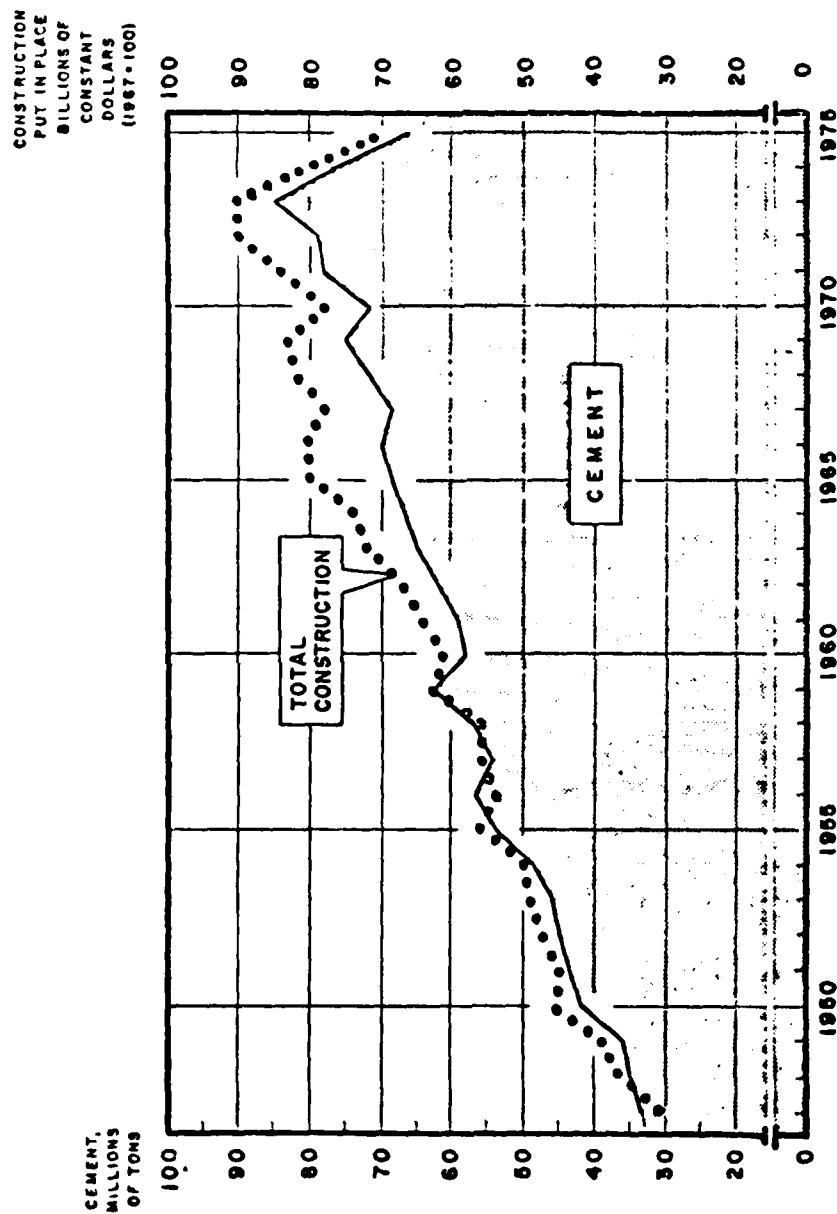


Figure 1.1-2.

SOURCE: PCA ECONOMIC RESEARCH DEPT.,
BUREAU OF MINES, U.S. DEPT. OF THE INTERIOR.

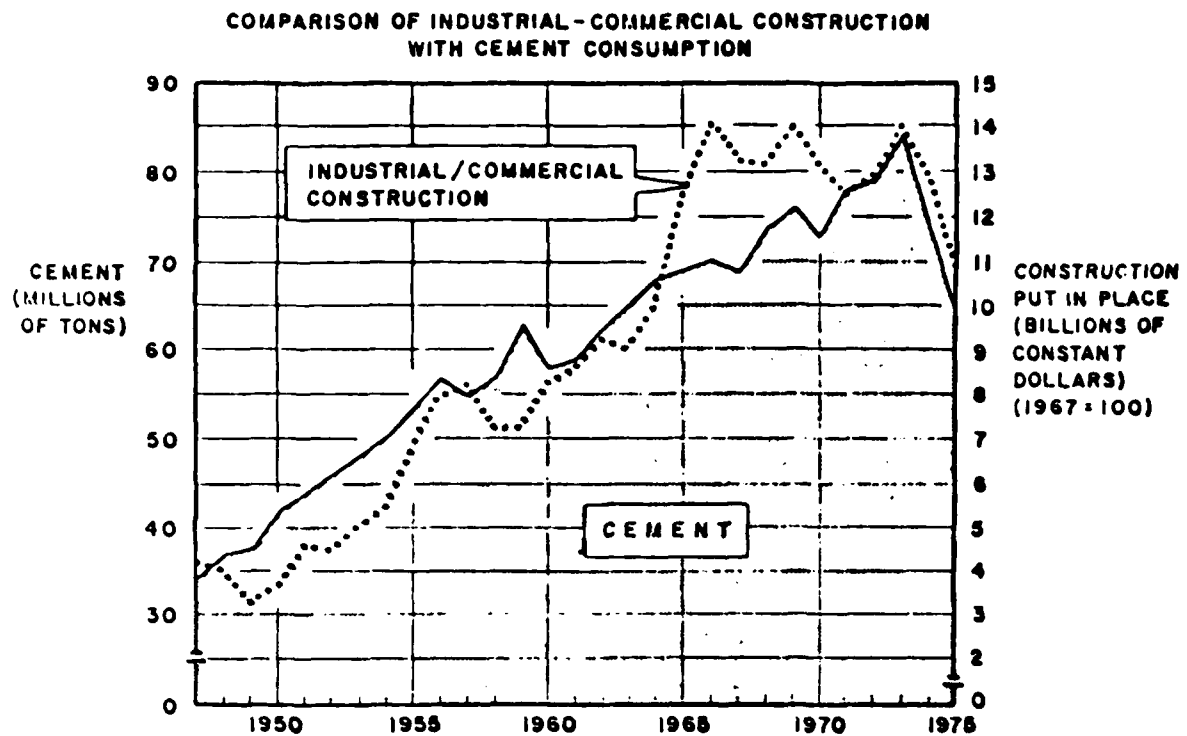


SOURCES: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE, BUREAU OF MINES.
U.S. DEPT. OF THE INTERIOR, PCA ECONOMIC RESEARCH DEPT.

3777 A

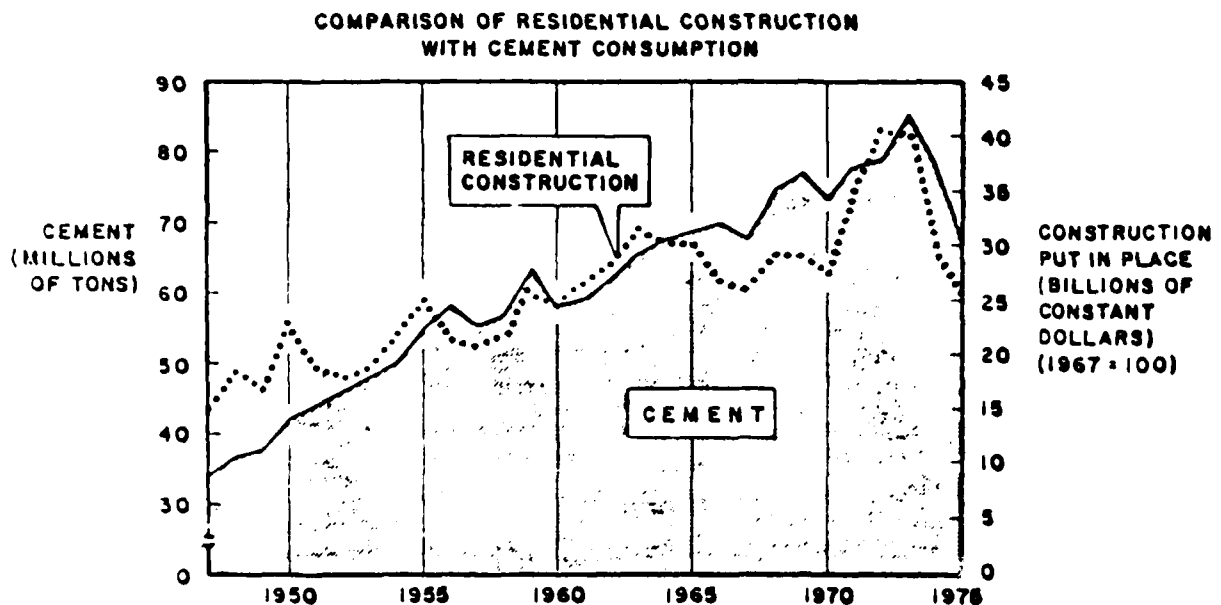
Figure 1.1-3. Comparison of total construction put in place with cement consumption.

Figure 1.1-4.



3725-A

Figure 1.1-5.



SOURCES: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE, BUREAU OF MINES,
U.S. DEPT. OF THE INTERIOR, PCA ECONOMIC RESEARCH DEPT.

3726-A

Figure 1.1-6.

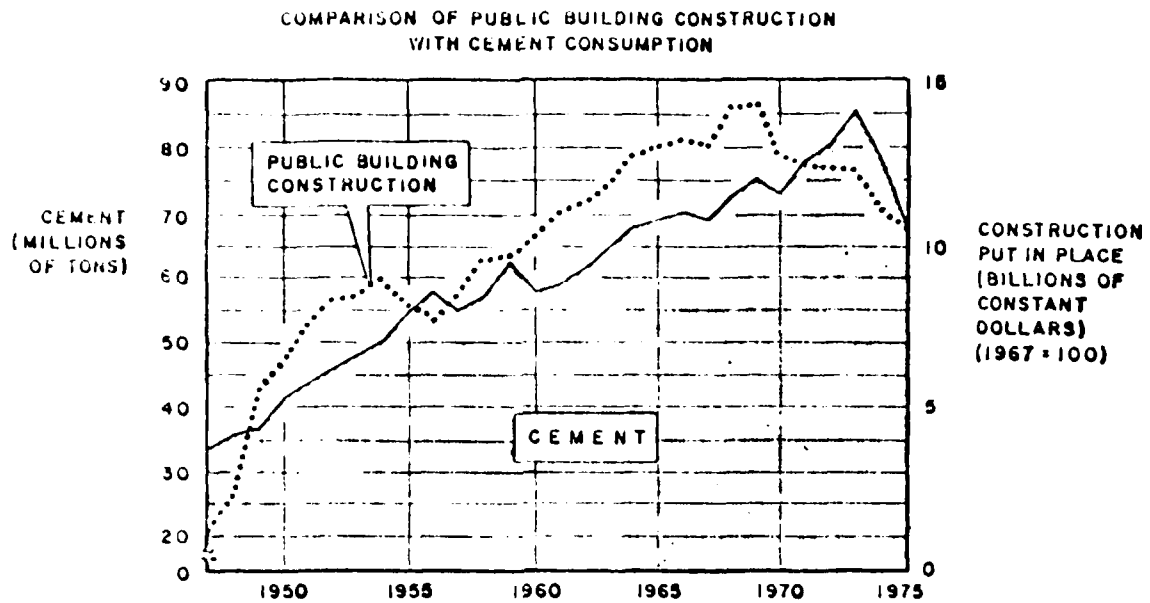
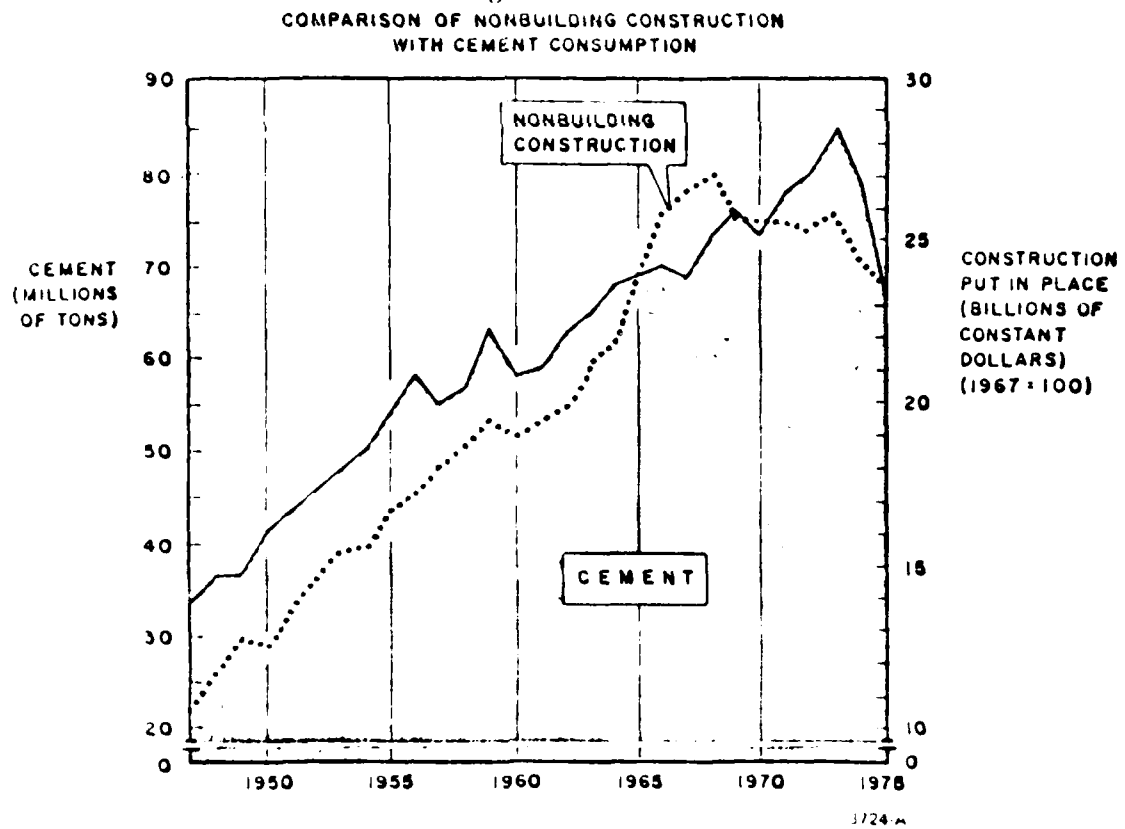


Figure 1.1-7.



SOURCES: CONSTRUCTION REVIEW, U.S. DEPT. OF COMMERCE; BUREAU OF MINES,
U.S. DEPT. OF THE INTERIOR; PCA ECONOMIC RESEARCH DEPT.

approximately 7.5 percent of total cement shipments. The increasing use of imported cement has partially resulted from the growth in shipments exceeding the growth in production.

Figure 1.1-8 sets forth the historical movement in cement prices from 1960 through 1978 in current dollars.

In 1960 the per ton price of cement was \$17.95. The price in current dollars declined gradually from 1960 through 1967, finally reaching a period low of \$16.87 per ton in 1967. Cement prices began moving upward in 1968 when the per ton price increased to \$16.95. The price of cement continued its upward movement but increases were dampened somewhat by the wage and price controls that were in effect in 1971 and 1972. Price controls were removed in the cement industry in November of 1973.

Since 1973 the price of cement has shown a rapid increase. In 1973 the cement price was \$22.23 per ton compared to \$41.17 in 1978, indicating an average compounded growth rate of 13.1 percent per year. Since 1960 the price of cement has increased at an average annual compounded rate of 4.7 percent.

A major causal factor for the rapid price increases experienced since 1973 is the cost of energy. The production of cement has been identified by the Department of Commerce as one of the six most energy intensive industries. Energy represents approximately one-third of the manufacturing cost of cement. Through a conscientious effort to conserve energy and reduce costs, the energy required to produce one ton of cement has declined from 7.75 million BTUs in 1950 to 6.31 million in 1976 (Portland Cement Association).

In addition, a greater reliance on coal is underway. Where feasible, plants relying on oil and gas as their primary fuel are converting to coal. In 1972 only 39 percent of cement production was manufactured with coal or coke compared to 55 percent in 1976. It is estimated that by 1980 almost 90 percent of cement capacity will be fueled by coal (Portland Cement Association, 1978).

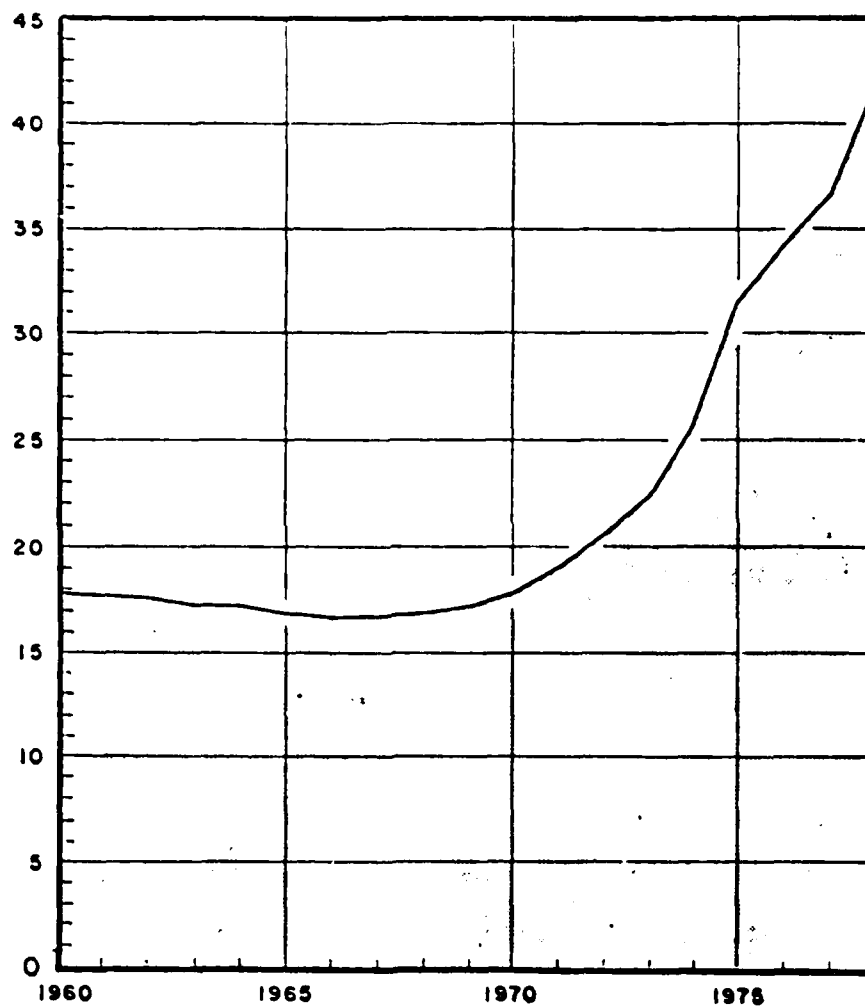
Prices in the future will largely be influenced by energy and transportation costs, levels of demand, production capacity, imports, and the structure of the cement industry.

Because of the low value to weight ratio, cement tends to be a regional industry with principal markets tending to range within a 200 mi radius of the plant. Beyond 200 mi overland transportation costs become excessive. Plants with access to navigable waters can significantly expand their markets up to possibly 1,000 mi from the point of production.

Generally, about 57.5 percent of all cement shipments occur within 99 mi of the producing plant. Over 95 percent of all shipments are within 300 mi of the producing plant.

Figure 1.1-9 illustrates the trend in the mode of transportation of cement. In 1975 trucks hauled the vast majority of cement, 86 percent. Although railroads transported 75 percent of all shipments in 1950, they transported only 13 percent in 1975. Water transportation has remained fairly constant at 1 percent of cement shipments.

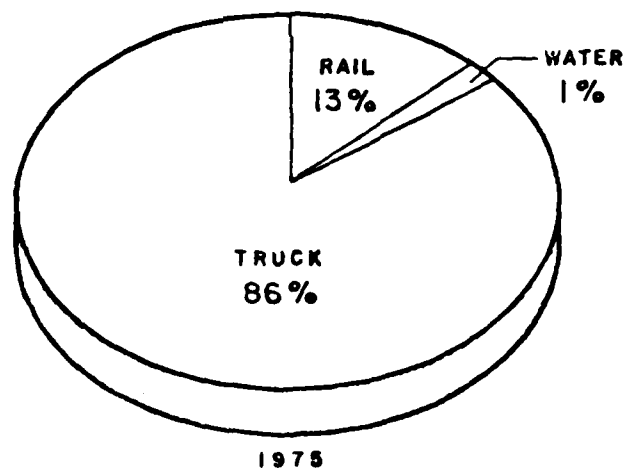
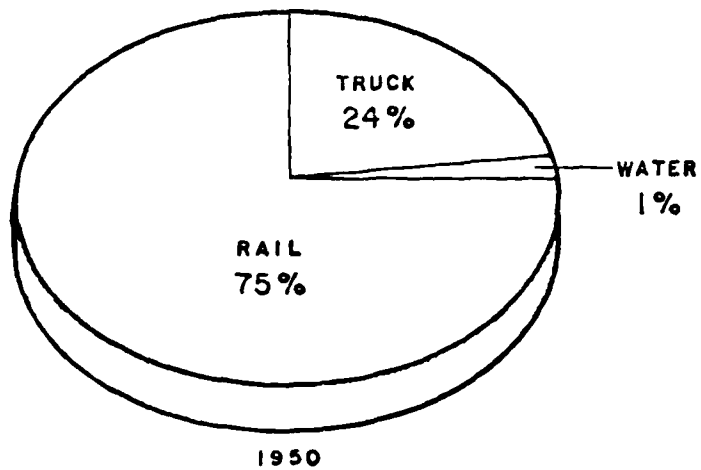
DOLLARS PER
SHORT TON



SOURCE: BUREAU OF MINES, MINERALS AND MATERIALS, A
MONTHLY SURVEY, JAN. 1980.

Figure 1.1-8. Cement prices in the United States, 1960-1978.

3730-A



SOURCE: BUREAU OF MINES, U.S. DEPT. OF THE INTERIOR,
PCA ECONOMIC RESEARCH DEPT.

3731-A

Figure 1.1-9. Trend in mode of transportation for cement shipments.

Because of the regional nature of the cement industry, prices can vary substantially from region to region. Regional shortages frequently develop and transportation costs make the solution to the problem expensive. For example, in the spring of 1978, 80,000 tons of cement were needed to complete a runway at Stapleton International Airport in Denver. Because local cement production was committed to extensive residential and building activity, it was necessary to ship cement by rail from as far away as Missouri. The freight costs increased the delivered cost of cement by more than \$10 per ton or about 47 cents per 94 pound bag over the price of local cement (U.S. Department of the Interior, Bureau of Mines, 1978).

Capacity utilization rates for plants producing Portland cement are set forth in Table 1.1-2. Capacity utilization rates have varied since 1970 from a high of 90.6 percent in 1972 to a low of 62.9 percent in 1975. Capacity utilization rates appear to be influenced by the general economy and demand; for instance, the low utilization rates in 1974 and 1975 coincide with the recession experienced in the United States during that time period and the resulting low demand for cement.

As of December 31, 1979, there were 49 cement companies operating 149 clinker-producing plants and eight grinding-only plants in 40 states. A list of cement companies and their respective capacities are set forth in Table 1.1-3. Current capacity for the United States portland cement industry totals 100,718,000 tons annually.

Cement company sizes range from firms with only one small plant to companies with as many as 13 plants. Even the largest multiplant cement producers are relatively small when compared to other firms in the steel, forest products, aluminum, and other construction materials industries.

The largest United States cement company, Lone Star Industries, Inc., accounted for 7.3 percent of the industry's total capacity in 1979. In terms of capacity, the top four companies had 24.7 percent, the top five 29.4 percent, and the top 10 less than 50 percent.

Texas, with an annual production capacity of 10,318,000 tons, is the leading state with respect to cement capacity. This represents about 10 percent of the industry's total capacity. With a capacity slightly smaller than Texas', California's capacity of 10,313,000 tons ranks the state second in the nation. Overall, five states -- Texas, California, Pennsylvania, Michigan, and New York -- accounted for approximately 43 percent of total capacity in 1979 (Portland Cement Association, 1979). Table 1.1-4 sets forth the production capacity of cement plants by state.

Announced capacity changes for the cement industry within the United States is as follows:

1980	3,503,000 tons
1981	3,410,000 tons
1982	2,688,000 tons
1983	315,000 tons
Total	<u>9,916,000 tons</u>

Source: Portland Cement Association, 1979.

Table 1.1-2. U.S. cement
industry capacity utili-
zation rates, 1970-1978.

YEAR	CAPACITY UTILIZED (PERCENT)
1970	88.4
1971	87.8
1972	90.6
1973	83.2
1974	74.8
1975	62.9
1976	68.4
1977	73.5
1978	77.8

3989

Source: U.S. Department of
the Interior, Bureau of
Mines, Minerals Yearbook.

Table 1.1-3. United States cement company capacities*

RANK	CEMENT (1,000 TON)	PERCENT INDUSTRY	NAME
(1)	(2)	(3)	(4)
1	7,313	7.3	Lone Star Industries, Inc.
2	6,460	6.4	Ideal Basic Industries
3	6,112	6.1	Gifford-Hill Co.
4	4,892	4.9	General Portland, Inc.
5	4,736	4.7	Martin Marietta Corp.
6	4,124	4.1	Medusa Corp.
7	4,117	4.1	Marquette
8	3,806	3.8	Universal Atlas Cement
9	3,743	3.7	Kaiser Cement and Gypsum Corp.
10	3,520	3.5	National Gypsum Company
11	3,480	3.5	Dundee Cement Company
12	3,200	3.2	Lehigh Portland Cement Co.
13	3,030	3.0	California Portland Cement Co.
14	2,960	2.9	Southwestern Cement
15	2,630	2.6	Missouri Portland
16	2,470	2.5	Louisville Cement Co.
17	2,417	2.4	Penn-Dixie Industries, Inc.
18	2,215	2.2	The Flintkote Co.
19	2,050	2.0	Alpha Portland Industries
20	2,025	2.0	Texas Industries, Inc.
21	1,768	1.8	Centrex Corporation
22	1,550	1.5	Atlantic Cement
23	1,460	1.4	OKC Corporation
24	1,420	1.4	Independent Cement Corporation
25	1,306	1.3	Ash Grove Cement Co.
26	1,200	1.2	Oregon Portland Cement Co.
27	1,150	1.1	River Cement Company
28	1,140	1.1	South Dakota Cement Plant
29	1,100	1.1	Coplay Cement
30	1,040	1.0	Citadel Cement
31	1,000	1.0	Northwestern States Portland Cement Co.
32	950	0.9	Columbia Cement
33	900	0.9	Gulf Coast Cement
34	900	0.9	The Monarch Cement Co.
35	855	0.8	Giant Portland and Masonry Cement Co.
36	850	0.8	Arkansas Cement
37	800	0.8	National Cement
38	790	0.8	The Whitehall Cement Manufacturing Co.
39	700	0.7	Monolith Portland Cement Co.
40	660	0.7	Florida Mining and Material Corp.
41	625	0.6	Keystone Portland Cement Co.
42	550	0.5	Aetna Cement
43	520	0.5	Rinker Cement
44	434	0.4	Alamo Cement Co.
45	400	0.4	Wyandotte Cement
46	375	0.4	SME Cement, Inc.
47	355	0.4	Capitol Aggregates Cement
48	350	0.3	National Portland of Florida
49	270	0.3	Cyprus Hawaiian Cement
TOTAL	100,718		

3990

* Includes gray, white, and grinding only facilities.

Source: Market and Economic Research, Portland Cement Association,
Old Orchard Road, Skokie, Illinois.

Table 1.1-4. United States cement plant, capacities by states.

RANK	CEMENT (1,000 TON)	STATES
(1)	(2)	(3)
1	10,318	Texas
2	10,313	California
3	9,590	Pennsylvania
4	7,576	Michigan
5	5,609	New York
6	4,981	Missouri
7	4,368	Florida
8	3,975	Alabama
9	3,791	Indiana
10	3,086	Iowa
11	2,923	Illinois
12	2,639	South Carolina
13	2,541	Ohio
14	2,386	Kansas
15	2,034	Tennessee
16	1,960	Oklahoma
17	1,950	Maryland
18	1,807	Washington
19	1,720	Arizona
20	1,646	Georgia
21	1,641	Colorado
22	1,245	Arkansas
23	1,200	Virginia
24	1,164	Louisiana
25	1,140	South Dakota
26	1,025	Nebraska
27	990	Oregon
28	935	West Virginia
29	780	Utah
30	740	Mississippi
31	660	Kentucky
32	650	Montana
33	610	North Carolina
34	590	Hawaii
35	505	New Mexico
36	480	Maine
37	430	Nevada
38	310	Wisconsin
39	210	Idaho
40	200	Wyoming
TOTAL	100,718	

3991

Note: There are no cement plants in the following states: Alaska, Connecticut, Delaware, District of Columbia, Massachusetts, Minnesota, New Hampshire, New Jersey, North Dakota, Rhode Island, and Vermont.

Source: Market and Economic Research, Portland Cement Association, Old Orchard Road, Skokie, Illinois.

In addition, approximately 1,640,000 tons of annual capacity is planned, although there is no indication of the operational date of the capacity changes.

A substantial proportion of the planned capacity changes through 1983 will occur in three states -- Texas, California, and Utah. By 1983 plans call for Texas to have an additional capacity of approximately 3,000,000 tons per year. Planned capacity additions for California total 2,692,000 tons and Utah's capacity is planned to increase by 1,150,000 tons. In addition 580,000 tons of annual capacity are planned for Utah, although there has been no indication of the operational date.

1.2 THE CEMENT INDUSTRY IN THE NEVADA/UTAH MARKET AREA

The regional market has been greatly enlarged beyond what would otherwise characterize the Nevada/Utah area.

The enlarged Nevada/Utah market area encompasses the following 11 western states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Production data for the 11 western states is set forth in Table 1.2-1. The data is reported on a district basis as defined by the Bureau of Mines.

The production of Portland cement within the 11 western states generally accounts for about 20 to 25 percent of the nation's total production. California is the only large producer located in the 11 western states, with historical production ranging from 7.3 to 9.5 million tons per year.

The district of Colorado, Arizona, Utah, and New Mexico is the second largest producing area of the West. Although geographically the district covers a large area, its production in 1978 totaled only 3.9 million tons.

In 1978 1.8 million tons of Portland cement were produced in the state of Washington, which is the second largest producing state in the west.

Relatively small production comes from other districts within the 11 western states. The district of Wyoming, Montana, and Idaho produced approximately 1.1 million tons in 1978 while production from Oregon and Nevada totaled about one million tons in 1978.

Cement production in the West has followed the same general pattern exhibited by the nation as a whole. Production in the West gradually increased, reaching a peak in 1973 of 16.4 million tons. With the recession of 1974 and 1975, production dropped to 15.0 and 13.7 million tons, respectively. The recovery brought about an increase in cement production in the western states. In fact, production in 1978 of 17.2 million tons exceeded the previous high reached in 1973 by approximately 5.0 percent.

Table 1.2-2 sets forth the historical consumption of portland cement by states for the Nevada/Utah market area.

Consumption in the total market area has increased from 11,614,000 tons in 1960 to 19,065,000 in 1979, an overall increase of approximately 62.4 percent from

Table 1.2-1. Nevada/Utah market area production of portland cement by district, 1960-1978.

YEAR	WYOMING, MONTANA, AND IDAHO	COLORADO, ARIZONA, UTAH, AND NEW MEXICO	OREGON AND NEVADA	WASHINGTON	CALIFORNIA	TOTAL
(THOUSANDS OF SHORT TONS)						
	(1)	(2)	(3)	(4)	(5)	(6)
1960	490	2,238	- ¹	1,550 ²	7,498	11,776
1961	524	2,581	- ¹	1,393 ²	7,738	12,236
1962	576	2,550	- ¹	1,352 ²	8,239	12,717
1963	680	2,549	- ¹	1,466 ²	8,664	13,359
1964	688	2,413	- ¹	1,550 ²	9,019	13,670
1965	677	2,222	704	1,143	8,491	13,237
1966	694	2,191	804	1,166	8,519	13,374
1967	655	2,063	638	1,106	7,905	12,367
1968	718	2,274	680	1,189	8,849	13,710
1969	380	2,263	657	1,189	9,542	14,531
1970	845	2,598	740	1,254	9,412	14,849
1971	942	2,954	840	1,324	9,105	15,165
1972	956	3,145	831	1,426	9,392	15,750
1973	1,047	3,441	908	1,462	9,502	16,360
1974	1,092	3,351	916	1,389	8,202	14,950
1975	1,005	3,295	858	1,379	7,211	13,748
1976	1,044	3,524	912	1,391	7,892	14,763
1977	1,118	3,858	904	1,636	9,040	16,556
1978	1,058	3,899	1,006	1,880	9,315	17,158

3992-1

¹Production data for Oregon included in Washington's total, no production data for Nevada until 1965.

²Washington's production includes Oregon from 1960-1964.

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

Table 1.2-2. Nevada/Utah market area, consumption of
portland cement, 1960-1979. (Page 1 of 2)

YEAR	ARIZONA	CALIFORNIA	COLORADO	IDAHO	MONTANA	NEVADA
	(THOUSANDS OF TONS)					
	(1)	(2)	(3)	(4)	(5)	(6)
1960	909	6,642	763	254	203	158
1961	1,017	7,108	888	212	204	184
1962	951	7,495	898	205	243	300
1963	869	7,956	895	215	282	393
1964	811	8,275	819	215	303	340
1965	627	7,932	946	272	281	319
1966	682	7,957	909	255	265	274
1967	673	7,180	863	212	205	219
1968	835	8,391	928	325	279	254
1969	973	8,745	906	476	390	316
1970	1,060	8,552	1,041	508	319	301
1971	1,364	8,530	1,239	438	306	413
1972	1,544	8,491	1,425	414	242	402
1973	1,711	8,608	1,593	429	282	467
1974	1,385	7,779	1,339	418	269	369
1975	1,086	6,847	1,162	393	253	366
1976	1,111	7,303	1,197	511	335	359
1977	1,480	8,414	1,406	509	349	510
1978	1,610	8,760	1,511	459	362	612
1979	1,800	9,544	1,516	471	335	610

3993

Table 1.2-2. Nevada/Utah market area, consumption of
portland cement, 1960-1979. (Page 2 of 2)

YEAR	NEW MEXICO	OREGON	UTAH	WASHINGTON	WYOMING	TOTAL
	(THOUSANDS OF TONS)					
	(7)	(8)	(9)	(10)	(11)	(12)
1960	451	582	393	1,061	198	11,614
1961	490	562	475	1,027	192	12,359
1962	441	572	537	937	207	12,786
1963	547	600	472	982	224	13,435
1964	519	574	475	1,009	239	13,579
1965	531	804	491	1,111	200	13,514
1966	512	805	426	1,490	184	13,759
1967	442	642	356	1,385	185	12,362
1968	536	681	386	1,257	184	14,056
1969	427	685	459	1,152	172	14,701
1970	429	644	419	1,136	186	14,595
1971	509	704	495	1,216	167	15,381
1972	566	806	652	1,091	194	15,827
1973	595	835	686	1,104	204	16,514
1974	586	825	684	1,167	245	15,066
1975	540	774	691	1,032	317	13,461
1976	543	794	920	1,168	418	14,659
1977	518	852	899	1,360	389	16,786
1978	632	968	900	1,631	385	17,830
1979	583	976	922	1,846	462	19,065

3993

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook
for data from 1960-1976; and Portland Cement Association, Market
and Economic Research Department Portland Cement Consumption for
data from 1977-1979.

1960 through 1979. Consumption in the 11 western states has been increasing at an average annual compounded growth rate of 2.6 percent.

Similar to the national pattern, the greatest decline in the consumption of cement occurred during the recession of 1974-75. Consumption dropped to 15,066,000 tons in 1974 from the previous high of 16,514,000 in 1973. A more abrupt decline occurred in 1975 with consumption dropping to 13,461,000 tons, some 3,053,000 tons less than the 1973 high. With the recovery, cement consumption increased dramatically with the 1979 consumption level surpassing the previous 1973 high by approximately 2,551,000 tons.

Of the 11 western states, California is by far the largest single consumer of cement. In 1979 California accounted for 50.1 percent of the total cement consumed in the market area. Other states that accounted for a substantial portion of cement consumption in 1979 were: (1) Washington, 9.7 percent; (2) Arizona, 9.4 percent; and (3) Colorado, 8.0 percent.

Although California and Washington are the two largest single consumers, their proportion of total consumption has steadily declined, partially due to the rapid growth of other states in the West.

Table 1.2-3 sets forth the growth rates of each state in the Nevada/Utah market area from 1960 through 1979.

The fastest growing states with respect to cement consumption are Nevada, Utah, and Wyoming. Cement consumption increased by over 286 percent in Nevada from 1960 through 1979. On an annual basis, consumption increased on the average of 7.4 percent contrasted to 2.6 percent for the area as a whole.

Cement use within the state of Utah increased rapidly from 393,000 tons in 1960 to 922,000 tons in 1979, a 134.6 percent increase. From 1960 through 1979, the annual growth rate has averaged 4.6 percent, substantially higher than the market area's growth rate.

Consumption of cement within Wyoming has also shown rapid growth. Overall, consumption increased by 133.3 percent from 1960-79.

Although the growth exhibited by the above three states with respect to cement consumption has been substantial, combined they accounted for only 10.5 percent of the area's total consumption.

The growth in consumption was lowest in New Mexico--from 1960 through 1979 cement consumption increased by only 29.3 percent. During the same period, consumption grew at only a 1.4 percent annual rate.

California was the only other state whose annual consumptive growth rate was below the market area's average. This is to be expected because California is by far the largest single consumer in the market area.

Table 1.2-4 sets forth the average shipments of portland cement by type of customers for 1976 through 1978.

Table 1.2-3. Nevada/Utah market area
consumption growth rates,
1960-1979.

STATE	PERCENT INCREASE 1960-1979	AVERAGE ANNUAL COMPOUNDED GROWTH RATE 1960-1979
	(1)	(2)
Arizona	98.0	3.7
California	43.7	1.9
Colorado	98.7	3.7
Idaho	85.4	3.3
Montana	65.0	2.7
Nevada	286.1	7.4
New Mexico	29.3	1.4
Oregon	67.7	2.8
Utah	134.6	4.6
Washington	74.0	3.0
Wyoming	133.3	4.6
TOTAL AREA	64.2	2.6

3994

Source: Sources for data for the above
table taken from U.S. Department
of the Interior, Bureau of Mines,
Minerals Yearbook, and Portland
Cement Association, Market and
Economic Research Department,
Portland Cement Consumption.

Table 1.2-4. Nevada/Utah market area, portland cement shipments by type of customers, 1976-1978 average.

DISTRICT ORIGIN	BUILDING MATERIALS DEALERS	CONCRETE PRODUCT MANUFAC- TURERS	READY MIXED CONCRETE	HIGHWAY CONTRAC- TORS	OTHER CONTRAC- TORS	FEDERAL, STATE, AND OTHER GOVERNMENT AGENCIES	MISCELLANEOUS
	P E R C E N T						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wyoming, Montana and Idaho	2.9	6.7	73.1	2.8	10.2	.4	3.8
Colorado, Arizona, Utah and New Mexico	6.3	10.4	69.3	4.6	5.6	.1	3.8
Washington	3.6	13.7	70.9	3.9	4.6	.2	3.0
Oregon and Nevada	5.7	9.7	75.3	4.6	4.3	.1	.3
California	9.1	13.2	70.3	2.5	3.7	.1	1.0

3995

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1976, Cement preprint from 1977, Minerals Yearbook, and Mineral Industry Surveys, Cement In 1978.

Ready-mixed concrete accounts for a substantial proportion of total consumption in the Nevada/Utah market area, ranging from 69.3 to 75.3 percent depending upon the state or district. This is slightly greater than the national average. Other major customers were concrete product manufacturers, highway contractors, other contractors, and building materials dealers.

The average price of cement from 1960 through 1978 for the Nevada/Utah market area is set forth in Table 1.2-5 and graphically illustrated in Figure 1.2-1.

Each of the districts set forth in Table 1.2-5 are characterized by different rates of growth with respect to prices over the 1960 through 1978 period.

California experienced the largest price change with prices increasing from \$17.24 per ton in 1960 to \$50.97 in 1978. On an annual basis, prices increased on the average of 6.2 percent. Closely following California was the district of Oregon and Nevada. Prices within these areas experienced an annual increase of approximately 5.7 percent from 1960 through 1978.

Prices increased at an annual rate of 5.5 percent in Washington and 5.4 percent in the district encompassing Colorado, Arizona, Utah, and New Mexico over the 1960-1978 period.

The district of Wyoming, Montana, and Idaho experienced the smallest increase in cement prices, only 4.9 percent per year during the 1960-1978 time period.

As of 1978, cement prices were the highest in Oregon and Nevada and the lowest in Wyoming, Montana, and Idaho.

Overall, the price of cement in the Nevada/Utah market area increased from \$17.72 in 1960 to \$49.51 in 1978. Prices increased at an average annual compounded rate of 5.9 percent. Similar to the price movements at the national level, the major increase in the price of cement occurred after 1973.

The cement capacity within each of the western states covers a wide range from a low of 200,000 tons to a high of over 10 million tons (see Table 1.2-6). California has by far the largest cement capacity of any western state. Its annual capacity of 10,313,000 tons ranks it second in the nation, only 5,000 tons less than number one ranked Texas. Cement capacity in California comprises approximately 54 percent of the total capacity existing in the 11 western states.

Other states exhibiting a cement plant capacity of over 1 million tons annually are: Washington, 1,807,000 tons; Arizona, 1,720,000 tons; and Colorado, 1,641,000 tons.

Overall, the combined capacity of the 11 western states totals 19,246,000 tons annually compared to the 19,065,000 tons consumed in 1979. In order for the western states to be self-sufficient in cement, all plants would have had to operate near capacity in 1979.

California has the largest number of producing cement plants in the West. Five plants in California have the capacity to produce over one million tons

Table 1.2-5. Nevada/Utah market area average value¹ of portland cement shipped by district origin, 1960-1978.

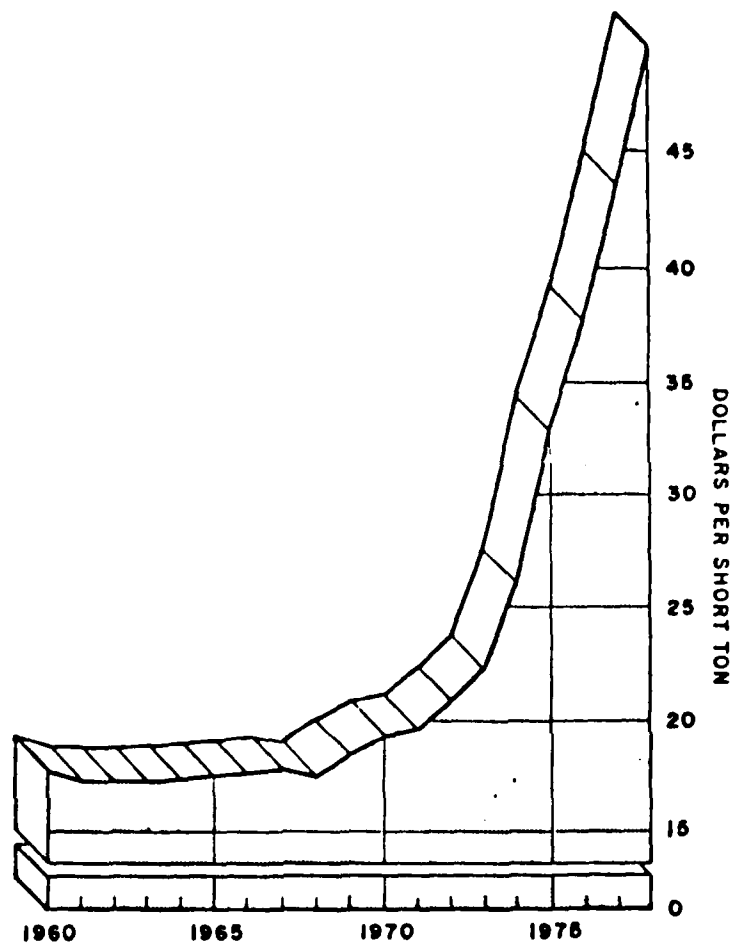
YEAR	COLORADO, ARIZONA, UTAH AND NEW MEXICO	WYOMING, MONTANA, AND IDAHO	OREGON AND NEVADA ²	WASHINGTON	CALIFORNIA	WEIGHTED AVERAGE
	(DOLLARS PER SHORT TON)					
	(1)	(2)	(3)	(4)	(5)	(6)
1960	\$18.14	\$19.36	\$18.73	\$18.73	\$17.24	\$17.72
1961	18.03	19.36	18.62	18.62	16.81	17.40
1962	17.66	19.15	18.78	18.78	16.97	17.40
1963	17.77	18.62	18.99	18.99	16.97	17.40
1964	18.03	18.57	19.10	19.10	16.92	17.45
1965	17.93	18.41	18.99	18.99	16.97	17.50
1966	17.98	17.77	19.21	18.99	17.13	17.61
1967	18.41	18.30	19.21	19.52	17.45	17.93
1968	18.51	18.73	19.05	19.36	16.97	17.66
1969	19.26	18.51	20.38	19.05	17.93	18.41
1970	20.80	18.99	20.54	20.32	18.62	19.26
1971	21.62	19.69	21.28	20.66	18.64	19.63
1972	22.43	21.43	22.15	21.67	20.06	20.93
1973	24.09	21.45	21.97	22.32	21.49	22.18
1974	27.40	26.04	25.53	26.40	25.48	26.04
1975	33.56	31.40	35.86	35.45	31.74	32.74
1976	37.18	36.08	40.94	39.31	37.19	37.52
1977	41.74	41.48	45.06	44.65	43.82	43.30
1978	46.92	45.38	51.01	49.24	50.97	49.51

3996

¹Mill value is the actual value of sales to customers, f.o.b. plant; less all discounts and allowances; less all freight charges to customer; less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any; less cost of paper bags and pallets.

²Prior to 1965, Nevada did not produce cement and Oregon and Washington were combined into one district. Since 1964 Oregon and Nevada were combined into one district and Washington was reported separately.

Source: U.S. Department of the Interior, Bureau of Mines.
Minerals Yearbook and Mineral Industry Surveys
Cement in 1978.



*weighted average

Source: U.S. Dept. of the Interior, Bureau of Mines, Minerals Yearbook.

Figure 1.2-1. Nevada/Utah market area average mill value* of portland cement.

Table 1.2-6. Nevada/Utah market area cement plant capacity by states.

STATE	CAPACITY RANK IN UNITED STATES	CEMENT CAPACITY (1,000 TONS)
	(1)	(2)
Arizona	19	1,720
California	2	10,313
Colorado	21	1,641
Idaho	39	210
Montana	32	650
Nevada	37	430
New Mexico	35	505
Oregon	27	990
Utah	29	780
Washington	18	1,807
Wyoming	40	200
Area Total		19,246

3997

Source: Portland Cement Association,
Market and Economic Research,
U.S. Portland Cement Industry:
Plant Information Summary,
December 31, 1979

annually. Arizona is the only other western state with a plant having the capacity to produce over 1 million tons per year.

Table 1.2-7 also sets forth the primary type of fuel utilized by each plant. Due primarily to the rising costs of oil and gas, the cement industry has been moving toward the use of coal whenever feasible. As indicated in Table 1.2-7, only a few plants use strictly oil and/or gas as a primary fuel. The majority of the cement plants in the West are coal fueled. Figure 1.2-2 sets forth the location of all cement producing plants in the West.

Planned capacity changes indicate that during 1980, cement capacity should increase by 1,349,000 tons. Of this, 1,154,000 tons of capacity will be located in the state of California. The remaining 115,000 and 80,000 tons of additional capacity will be in Colorado and Wyoming, respectively (see Table 1.2-8).

The only capacity expansion planned for 1981 is 1,000,000 tons at Mojave, California.

Capacity expansions planned for 1982 include two additional cement plants in Utah. The combined capacity of both plants will total 1,150,000 tons of cement and will provide a substantial increase (147 percent) to Utah's current capacity of 780,000 tons. In addition, Ideal Cement Company has tentative plans to increase its Devil's Slide plant by 538,00 tons, but at this time the projected operational date is unknown.

Table 1.2-9 sets forth the capacity utilization of the districts comprising the Nevada/Utah market area from 1973 through 1978. Over the six year period, the districts of Wyoming, Montana, and Idaho have averaged the highest capacity utilization rate of 87.7 percent.

Other districts and their respective six year average capacity utilization rates are: California, 76.8 percent; Washington, 71.0 percent; Oregon/Nevada, 66.8 percent; and the district encompassing Colorado, Arizona, Utah, and New Mexico, 66.1 percent.

1.3 THE CEMENT INDUSTRY IN THE TEXAS/NEW MEXICO MARKET AREA

The Texas/New Mexico market area is broadened to reflect a geographical market with characteristics similar to the Nevada/Utah market area.

The enlarged Texas/New Mexico market area encompasses the following states: Arizona, Arkansas, Colorado, Kansas, Louisiana, Mississippi, Missouri, New Mexico, Oklahoma, Texas, and Utah.

Table 1.3-1 sets forth the production of portland cement for districts and states of the Texas/New Mexico market area. This market area accounts for approximately 25 to 30 percent of the total production of portland cement in the nation.

Texas is the single largest producer within the market area accounting for approximately 36 percent of the area's total production. The production of cement in Texas has grown rapidly since the early 1960s. In 1960 Texas produced about 4.4 million tons compared to 8.6 million in 1978.

Table 1.2-7. Nevada/Utah market area by plant capacity
(Page 1 of 2).

STATE	CAPACITY (1,000 Tons)	PLANT NAME	PRIMARY FUEL	LOCATION
(1)	(2)	(3)	(4)	(5)
Arizona	1,100	California Portland	Coal	Rillito, Az.
	620	Phoenix	Coal	Clarkdale, Az.
California	1,598	Kaiser	Coal	Permanente, Ca.
	1,179	Riverside	Coal	Oro Grande, Ca.
	1,150	California Portland	Coal	Mojave, Ca.
	1,130	Southwestern	Oil/Gas	Victorville, Ca.
	1,015	Kaiser	Gas	Lucerne Valley, Ca.
	900	Riverside	Coal	Riverside, Ca.
	780	California Portland	Coal	Colton, Ca.
	630	Flintkote	Coal	San Andreas, Ca.
	610	General	Coal	Lebec, Ca.
	500	Monolith	Coal	Monolith, Ca.
	395	Lone Star	Oil	Davenport, Ca.
	280	Flintkote	Coal	Redding, Ca.
	146	Riverside ¹		Riverside, Ca.
Colorado	885	Ideal	Coal/Oil	Portland, Co.
	431	Martin Marietta	Coal	Lyons, Co.
	325	Ideal	Coal/Gas	Boettcher, Co.
Idaho	210	Oregon Portland	Coal	Inkom, Id.
Montana	330	Ideal	Coal	Trident, Mt.
	320	Kaiser	Gas	Montana City, Mt.
Nevada	430	Centex	Coal	Fernley, Nv.
New Mexico	505	Ideal	Coal	Tijeras, NM.
Oregon	500	Oregon Portland	Coal	Durkee, Or.
	360	Oregon Portland	Coal/Oil	Lake Oswego, Or.
	130	Oregon Portland	Coal	Huntington, Or.
Utah	420	Lone Star	Coal/Oil/Gas	Salt Lake City, Ut.
	360	Ideal	Coal/Gas	Devils Slide, Ut.

3998

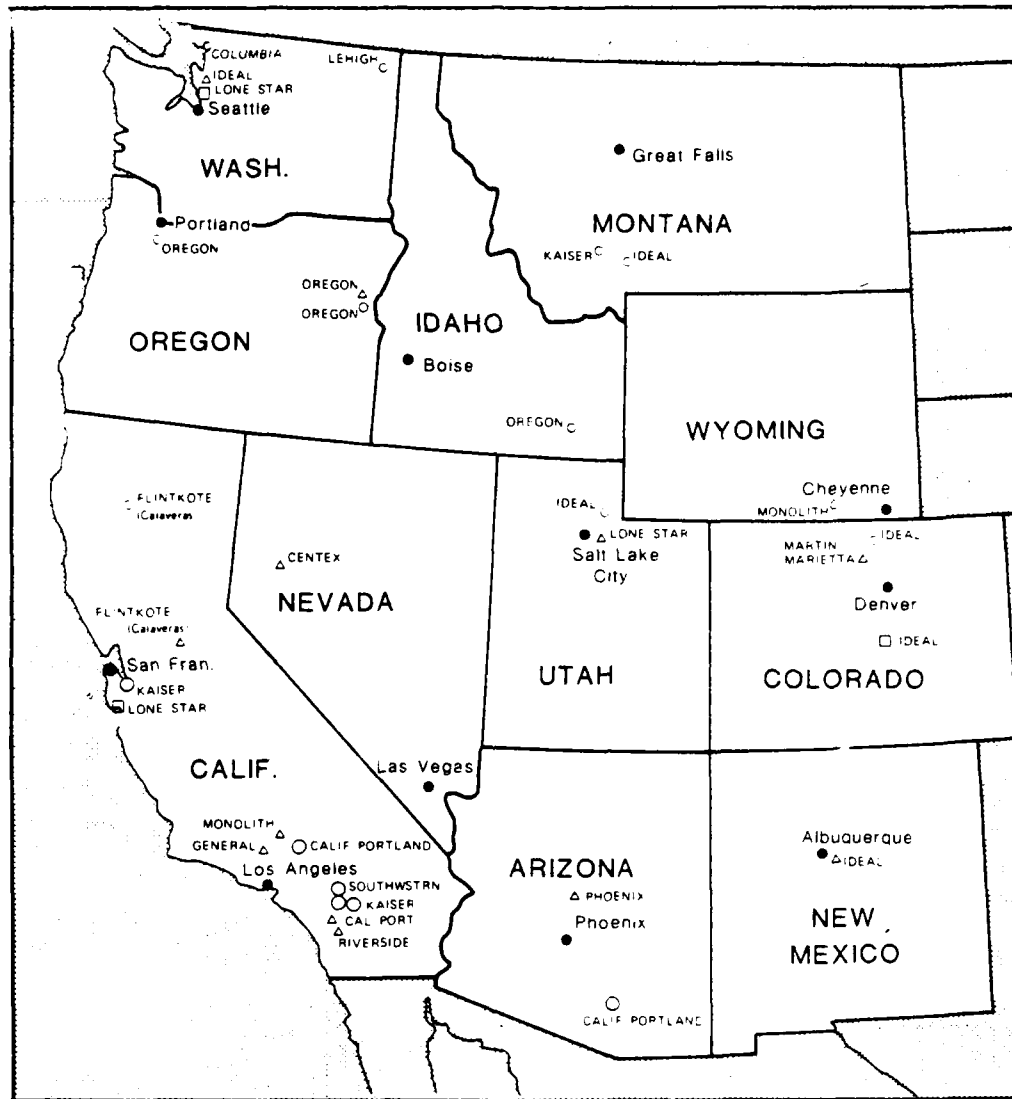
Table 1.2-7. Nevada/Utah market area by plant capacity (Page 2 of 2).

STATE	CAPACITY (1,000 Tons)	PLANT NAME	PRIMARY FUEL	LOCATION
	(2)	(3)	(4)	(5)
Washington	752	Lone Star	Coal	Seattle, Wa.
	490	Ideal	Coal	Seattle, Wa.
	350	Columbia	Coal/Oil/Gas	Bellingham, Wa.
	215	Lehigh	Coal	Metalline Falls, Wa.
Wyoming	200	Monolith	Coal	Laramie, Wy.
Area Total	19,246			

3998

¹Manufacturer of white cement.

Source: Portland Cement Association, Market and Economic Research,
U.S. Portland Cement Industry: Plant Information Summary,
December 31, 1979



SOURCE: PORTLAND CEMENT ASSOC. MARKET AND
ECONOMIC RESEARCH. U.S. PORTLAND CEMENT
INDUSTRY PLANT INFORMATION SUMMARY
DEC. 31, 1979

ANNUAL PRACTICAL CAPACITY
C UNDER 400,000 TONS
Δ 400,000 TO 700,000 TONS
□ 700,000 TO 1,000,000 TONS
○ OVER 1,000,000 TONS

Figure 1.2-2. Locations of cement producing plants in the western United States.

Table 1.2-8. Nevada/Utah market area announced cement/clinker capacity changes as of December 31, 1979.

PLANT NAME	PROJECTED OPERATIONAL DATE	LOCATION	CAPACITY 1,000 TONS		
			EXISTING	PROJECTED	NET DIFFERENCE
(1)	(2)	(3)	(4)	(5)	(6)
Flintkote	1980	Redding, Ca.	280	600	320
Lone Star	1980	Davenport, Ca.	396	730	334
Monolith	1980	Monolith, Ca.	500	1,000	500
Ideal	1980	Boettcher, Col.	310	425	115
Monolith	1980	Laramie, Wy.	200	280	80
Total	1980				<u>1,349</u>
California/Portland	1981	Mojave, Ca.	1,150	2,150	1,000
Total	1981				<u>1,000</u>
Kaiser	1982	Lucerne Valley, Ca.	962	1,500	538
Lone Star	1982	Grantsville, Utah	New	500	500
Martin-Marietta	1982	Leamington, Utah	New	650	650
Total	1982				<u>1,688</u>
Ideal	Unknown	Devils Slide, Utah	360	940	580
Total					<u>580</u>

3999

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1979.

Table 1.2-9. Portland cement capacity utilization,
Nevada/Utah market area, 1973-1978.

YEAR	WYOMING, MONTANA, AND IDAHO	COLORADO, ARIZONA, UTAH, AND NEW MEXICO	OREGON AND NEVADA	WASHINGTON	CALIFORNIA
	PERCENT				
	(1)	(2)	(3)	(4)	(5)
1973	86.3	72.4	65.6	64.7	83.1
1974	89.6	62.3	66.1	61.5	74.3
1975	83.1	57.9	61.9	65.0	65.3
1976	85.6	62.1	65.8	67.2	73.0
1977	93.2	71.7	65.2	78.0	82.0
1978	88.2	70.3	75.9	89.7	83.3
Six-year Average	87.7	66.1	66.8	71.0	76.8

4000

Source: U.S. Department of the Interior, Bureau of Mines,
Minerals Yearbook

Table 1.3-1. Texas/New Mexico market area production
of portland cement by district, 1960-1978.

YEAR	LOUISIANA AND MISSISSIPPI	MISSOURI	KANSAS	OKLAHOMA AND ARKANSAS	TEXAS	COLORADO, ARIZONA, UTAH, AND NEW MEXICO	TOTAL
THOUSANDS OF SHORT TONS							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1960	1,366	2,370	1,503	1,345	4,359	2,238	13,181
1961	1,243	2,244	1,566	1,709	4,678	2,581	14,021
1962	1,480	2,301	1,548	1,802	4,970	2,550	14,651
1963	1,583	2,386	1,550	2,124	5,479	2,549	15,671
1964	1,701	2,331	1,567	2,144	5,600	2,413	15,756
1965	1,696	2,627	1,669	2,274	5,784	2,222	16,272
1966	1,739	2,623	1,724	2,353	5,919	2,191	16,549
1967	1,681	2,798	1,696	2,325	6,067	2,063	16,630
1968	1,578	3,723	1,858	2,366	6,421	2,274	18,220
1969	1,427	3,921	1,830	2,421	6,734	2,263	18,596
1970	1,289	3,897	1,687	2,083	6,501	2,598	18,055
1971	1,486	4,144	1,799	2,374	7,138	2,954	19,895
1972	1,602	4,329	1,986	2,604	7,884	3,145	21,550
1973	1,479	4,359	2,036	2,746	8,312	3,441	22,373
1974	1,699	4,298	1,996	2,695	9,961	3,351	24,000
1975	1,330	3,919	1,835	2,232	7,074	3,295	19,685
1976	1,551	4,334	1,950	2,620	7,438	3,524	21,417
1977	1,538	4,551	2,072	2,771	8,223	3,858	23,013
1978	1,586	4,620	2,063	2,774	8,624	3,899	23,566

4007

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

Production within Missouri is the second largest within the Texas/New Mexico market area. Production within Missouri accounted for approximately 17 to 20 percent of the area's total production. Similar to Texas, Missouri has shown a fairly rapid increase in cement production. In 1960 Texas produced about 2.4 million tons compared to 4.6 million in 1978.

Other producing districts and 1978 production were: Colorado, Arizona, Utah, and New Mexico, 3.9 million tons; Oklahoma and Arkansas, 2.8 million tons; Kansas, 2.1 million tons; and Louisiana and Mississippi, 1.6 million tons.

Similar to the West and the nation as a whole, cement production in the market area increased gradually throughout the 1960s reaching 22,373,000 tons in 1973. During the recession in 1974, production increased to 24 million tons. In 1975 production finally declined to 19,685,000 tons. With the recovery, production gradually increased from the 1973 level reaching 23,566,000 tons in 1978.

The consumption of portland cement by states within the Texas/New Mexico market area is set forth in Table 1.3-2.

Cement consumption within the total market area increased from 12,206,000 tons in 1960 to 22,910,000 tons in 1978, an overall increase of approximately 88 percent. The average annual compounded growth rate in consumption for the Texas/New Mexico area from 1960 through 1979 was approximately 3.4 percent compared to a growth rate of 2.6 for the Nevada/Utah market area.

Unlike the western and national trends, the recession of 1974 and 1975 did not significantly affect the consumption of cement in the Texas/New Mexico market area. In fact, consumption declined by only 1.5 million tons in 1974 and then increased by approximately 1.3 million tons in 1975. The growth in consumption throughout the 1960-1979 period can be characterized as gradually increasing.

Texas is not only the largest cement consuming state within the market area, but also one of the fastest growing states with respect to consumption. Since 1960 consumption within Texas has increased at an average annual compounded growth rate of approximately 4.5 percent. Table 1.3-3 sets forth the overall and annual growth rates in consumption for the states within the Texas/New Mexico market area.

Other states with rapidly growing annual consumptive growth rates were Utah, Colorado, and Arizona.

The consumption of portland cement by customer category is set forth in Table 1.3-4. Similar to the west and the nation as a whole, the majority of cement shipments are used for ready mixed concrete. However, individual districts vary substantially, with the ready mix market receiving as low as 55.0 percent in Louisiana and Mississippi and as high as 76.3 percent in Missouri of the average of cement shipments from 1976 and 1978.

Other customer categories showed similar variation, but generally other large consumers included: (1) highway contractors, (2) concrete product manufacturers, (3) other contractors, and (4) building materials dealers.

Table 1.3-2. Texas/New Mexico market area consumption of portland cement, 1960-1969.

YEAR	ARIZONA	ARKANSAS	COLORADO	KANSAS	LOUISIANA	MISSISSIPPI	MISSOURI	NEW MEXICO	OKLAHOMA	TEXAS	UTAH	TOTAL
THOUSANDS OF TONS												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1960	909	487	763	953	1,505	625	1,445	451	878	3,797	393	12,206
1961	1,017	558	888	1,085	1,479	677	1,516	490	1,048	4,054	475	13,287
1962	951	574	898	1,002	1,669	696	1,657	441	1,117	4,305	537	13,847
1963	869	669	895	945	1,713	752	1,690	547	1,336	4,628	472	14,516
1964	811	716	819	965	1,956	772	1,930	519	1,159	4,917	475	15,039
1965	627	850	946	948	2,123	792	1,958	531	1,294	4,958	491	15,518
1966	682	922	909	964	2,184	885	1,735	512	1,000	5,075	426	15,303
1967	673	834	863	894	2,213	794	1,759	442	989	5,068	356	14,885
1968	835	834	928	1,077	2,358	822	1,825	536	1,136	5,331	386	16,068
1969	973	723	906	1,063	2,199	832	1,800	427	1,369	5,650	459	16,401
1970	1,060	615	1,041	964	1,902	814	1,747	429	1,236	5,413	419	15,640
1971	1,364	783	1,239	983	2,179	789	2,026	509	1,216	6,159	459	17,742
1972	1,544	838	1,425	1,048	2,358	929	1,798	566	1,398	6,786	652	19,342
1973	1,711	866	1,593	1,126	2,335	968	1,876	595	1,419	6,821	686	19,996
1974	1,385	883	1,339	1,146	2,365	911	1,715	586	1,474	6,359	684	18,847
1975	1,086	802	1,162	1,122	2,191	813	1,635	540	1,186	6,130	691	17,358
1976	1,111	885	1,197	1,229	2,486	830	1,723	543	1,262	6,469	920	18,655
1977	1,480	930	1,406	1,230	2,536	943	1,791	618	1,592	7,873	899	21,298
1978	1,610	952	1,511	1,233	2,861	1,019	2,040	632	1,660	8,469	900	22,887
1979	1,800	888	1,516	1,292	2,744	947	1,848	583	1,660	8,701	922	22,910

1008

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook for data from 1960-1976; and Portland Cement Association, Market and Economic Research Department, Portland Cement Consumption for data from 1977-1979.

Table 1.3-3. Texas/New Mexico market area consumption growth rates 1960-1979.

STATE	PERCENT INCREASE 1960-1979	AVERAGE ANNUAL COMPOUNDED GROWTH RATE 1960-1979
	(PERCENT)	
Arizona	98.0	3.7
Arkansas	82.3	3.2
Colorado	98.7	3.7
Kansas	35.6	1.6
Louisiana	82.3	3.2
Mississippi	51.5	2.2
Missouri	27.9	1.3
New Mexico	29.3	1.4
Oklahoma	90.1	3.4
Texas	129.2	4.5
Utah	134.6	4.6
Total Area	87.7	3.4

4009

Source: Sources for data for the above table taken from U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, and Portland Cement Association, Market and Economic Research, Portland Cement Consumption.

Table 1.3-4. Texas/New Mexico market area portland cement shipments by type of customers, 1976-1978 average.

DISTRICT ORIGIN	BUILDING MATERIALS DEALERS	CONCRETE PRODUCT MANUFACTURERS	READY-MIXED CONCRETE	HIGHWAY CONTRACTORS	OTHER CONTRACTORS	FEDERAL, STATE, AND OTHER GOVERNMENT AGENCIES	MISCELLANEOUS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Colorado, Arizona, Utah, and New Mexico	6.3	10.4	69.3	4.6	5.6	.1	3.8
Oklahoma and Arkansas	7.0	9.3	63.9	12.9	5.1	.1	1.6
Kansas	6.0	6.9	71.3	6.5	4.7	-	4.4
Louisiana and Mississippi	10.5	7.5	55.0	6.3	12.7	5.1	2.9
Missouri	2.4	9.5	76.3	10.3	1.4	-	.1
Texas	7.8	9.3	61.8	3.7	12.6	1.1	3.6

Source: U.S. Department of the Interior, Bureau of Mines. Minerals Yearbook, 1976, Cement, preprint from the 1977 Minerals Yearbook, and Mineral Industry Surveys, Cement In 1978.

4010

The average price of portland cement in the Texas/New Mexico market area from 1960 through 1978 is set forth in Table 1.3-5 and graphically illustrated in Figure 1.3-1.

Texas experienced the largest price change, with prices increasing from \$17.34 per ton in 1960 to \$45.55 in 1978. On an average annual compounded basis, prices increased approximately 5.5 percent per year from 1960 through 1979.

Over the same period (1960-1978), prices in the district encompassing the states of Colorado, Arizona, Utah, and New Mexico and the Oklahoma/Arkansas district increased at an annual rate of 5.4 and 5.2 percent, respectively.

The smallest increase in prices over the 18-year period was experienced in Missouri--from 1960 through 1978, prices increased on the average of 4.0 percent per year.

The price of cement in the overall Texas/New Mexico market area increased from \$17.56 per ton in 1960 to \$42.77 in 1978, an average annual compounded growth rate of approximately 5.1 percent.

The cement production capacity of each of the states within the Texas/New Mexico market area is set forth in Table 1.3-6. Texas has the largest cement capacity within the market area and the nation. Capacity of 10,318,000 tons in Texas accounts for 37.6 of the total capacity within the market area.

Missouri is another state which has a substantial cement capacity. Currently, plants in Missouri have the capacity to produce 4,981,000 tons annually, ranking the state sixth in the nation.

Other states with plants having a relatively large cement capacity include: Kansas with 2,386,000 tons and Oklahoma with 1,960,000 tons. Within the Texas/New Mexico market area there are eight states with a cement capacity exceeding 1 million tons per year.

The combined capacity within the Texas/New Mexico market area totals 27,440,000 tons compared to consumption of 22,910,000 tons in 1979. Table 1.3-7 sets forth the cement capacity of each plant within the states comprising the market area.

It is not surprising that Texas has the largest number of producing cement plants in the market area. What is unusual is that only one plant can produce over 1 million tons per year.

Missouri, which ranks second in production within the Texas/New Mexico market area, has seven producing plants with two producing over 1 million tons annually.

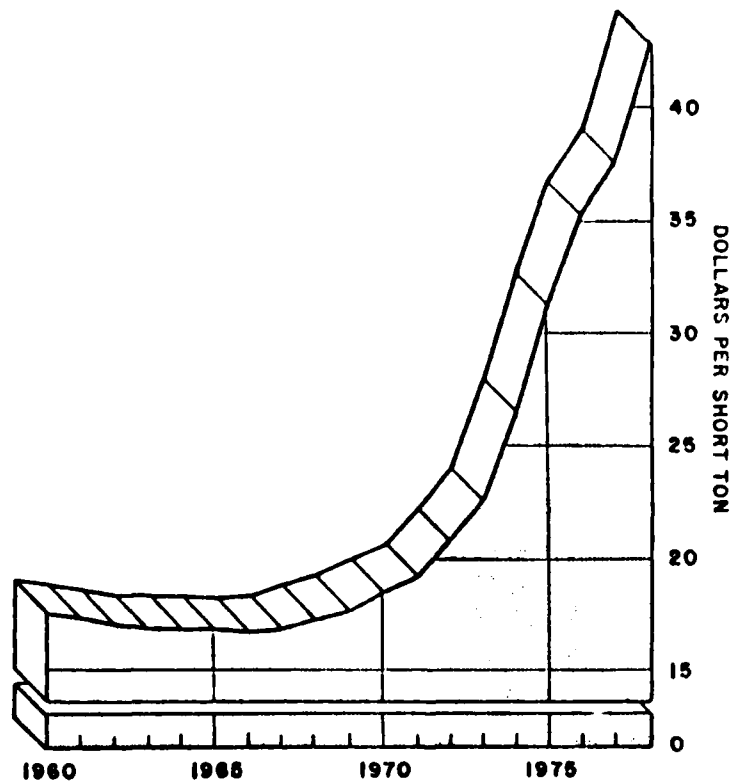
Table 1.3-7 also sets forth the primary fuel of each producing plant. Because of the rising costs associated with oil and gas, when feasible, cement plants have switched to coal as a primary fuel. Most of the plants within the Texas/New Mexico market area are fueled by coal, although the use of gas is more extensive than in the West. Figure 1.3-2 sets forth the location of all cement producing plants in the Texas/New Mexico market area.

Table 1.3-5. Texas/New Mexico market area average value¹ of portland cement shipped by district origin, 1960-1978.

YEAR	DOLLARS PER SHORT TON						
	COLORADO ARIZONA UTAH AND NEW MEXICO	OKLAHOMA AND ARKANSAS	KANSAS	LOUISIANA AND MISSISSIPPI	MISSOURI	TEXAS	WEIGHTED AVERAGE
1960	\$18.14	\$16.44	\$17.02	\$17.66	\$18.35	\$17.34	\$17.56
1961	18.03	16.55	16.97	16.86	18.51	17.13	17.40
1962	17.66	15.48	16.60	16.86	18.35	16.86	17.08
1963	17.77	15.59	16.44	16.97	17.88	16.97	16.97
1964	18.03	15.64	16.28	16.70	18.30	16.76	16.97
1965	17.93	15.16	16.28	17.08	18.35	16.86	16.97
1966	17.98	21.07	16.12	16.86	17.77	16.76	16.86
1967	18.41	15.91	15.37	16.86	18.41	16.55	16.92
1968	18.51	15.64	16.44	17.40	18.89	16.60	17.24
1969	19.26	16.01	16.01	17.66	18.57	17.40	17.61
1970	20.80	17.66	16.28	19.58	16.12	19.26	18.35
1971	21.62	18.68	17.31	19.63	17.18	19.48	19.04
1972	22.43	19.43	18.76	20.53	18.91	21.97	20.76
1973	24.09	21.55	20.82	23.91	21.79	22.76	22.55
1974	27.40	26.10	24.20	29.09	25.30	26.84	26.48
1975	33.56	30.14	30.04	32.22	29.34	31.24	31.09
1976	37.18	33.98	33.16	34.74	32.85	36.69	35.20
1977	41.74	35.76	36.05	36.16	33.51	39.11	37.59
1978	46.92	41.18	37.79	43.06	37.17	45.55	42.77

¹Mill value is the actual value of sales to customers, f.o.b. plant; less all discounts and allowances, less all freight charges to customer, less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any, less cost of paper bags and pallets.

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook and Mineral Industry Surveys Cement 1978.



*weighted average

Source: U.S. Dept. of the Interior, Bureau of Mines, Mineral Yearbook.

Figure 1.3-1. Texas/New Mexico market area average mill value* of portland cement.

Table 1.3-6. Texas/New Mexico cement plant capacity by state.

STATE	CAPACITY RANK IN UNITED STATES	CEMENT CAPACITY (1,000 Tons)
Arizona	19	1,720
Arkansas	22	1,245
Colorado	21	1,641
Kansas	14	2,386
Louisiana	24	1,164
Mississippi	30	740
Missouri	6	4,981
New Mexico	35	505
Oklahoma	16	1,960
Texas	1	10,318
Utah	29	780
Area Total		27,440

4012

Source: Portland Cement Association,
Market and Economic Research,
U.S. Portland Cement Industry:
Plant Information Summary,
December 31, 1979.

Table 1.3-7. Texas/New Mexico market area by plant capacity.

STATE	CAPACITY (1,000 tons)	PLANT NAME	PRIMARY FUEL	LOCATION
Arizona	1,100	California Portland	Coal	Rillito, AZ
	620	Phoenix	Coal	Clarkdale, AZ
Kansas	850	Arkansas Cement	Coal	Foreman, AZ
	395	Ideal	Gas	Okay, AZ
Colorado	885	Ideal	Coal/Oil	Portland, CO
	431	Martin Marietta	Coal	Lyons, CO
	325	Ideal	Coal/Gas	Boettcher, CO
Kansas	600	Monarch	Coal/Gas	Humboldt, KS
	516	Ash Grove	Coal	Chanute, KS
	451	Lone Star	Coal	Bonner Springs, KS
	412	Universal Atlas	Gas	Independence, KS
	407	General	Coal	Fredonia, KS
Louisiana	750	OKC	Coal	New Orleans, LA
	414	Lone Star	Gas	New Orleans, LA
Mississippi	525	Texas Industries	Gas	Artesia, MS
	215	Marquette	Coal/Oil/Gas	Brandon, MS
Missouri	1,260	Dundee	Coal	Clarksville, MO
	1,150	River	Coal	Selma, MO
	752	Missouri Portland	Coal	St. Louis, MO
	625	Universal Atlas	Coal	Hannibal, MO
	564	Missouri Portland	Coal	Kansas City, MO
	350	Marquette	Coal	Cape Girardeau, MO
	280	Alpha	Coal	St. Louis (Lemay), MO
New Mexico	505	Ideal	Coal	Tijeras, NM
Oklahoma	710	OKC	Coal	Pryor, OK
	630	Martin Marietta	Coal	Tulsa, OK
	620	Ideal	Coal	Ada, OK
Texas	1,500	Texas Industries	Coal	Midlothian, TX
	900	Gulf Coast	Coal	Houston, TX
	846	Gifford-Hill	Coal	Midlothian, TX
	731	General	Coal	Fort Worth, TX
	642	Centex	Coal	Buda, TX
	620	Ideal	Coal/Gas	Houston, TX
	550	Southwestern	Gas	Odessa, TX
	545	Lone Star	Coal	Maryneal, TX
	526	Lone Star	Gas	Houston, TX
	490	Kaiser	Coal	San Antonio, TX
	475	General	Coal/Gas	Dallas, TX
	434	Alamo Cement Co.	Coal/Gas	Cementville, TX
	355	Capital Aggregates	Coal/Gas	San Antonio, TX
	352	Universal Atlas	Gas	Waco, TX
	330	Southwestern	Coal/Oil/Gas	El Paso, TX
Utah	325	Alpha	Coal	Orange, TX
	320	Centex	Coal	Corpus Christi, TX
	220	Southwestern	Gas	Amarillo, TX
	420	Lone Star	Coal/Oil/Gas	Salt Lake City, UT
	360	Ideal	Coal/Gas	Devils Slide, UT
Area Total	27 440			

4013

Source Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry Plant Information Summary, December 31, 1979.

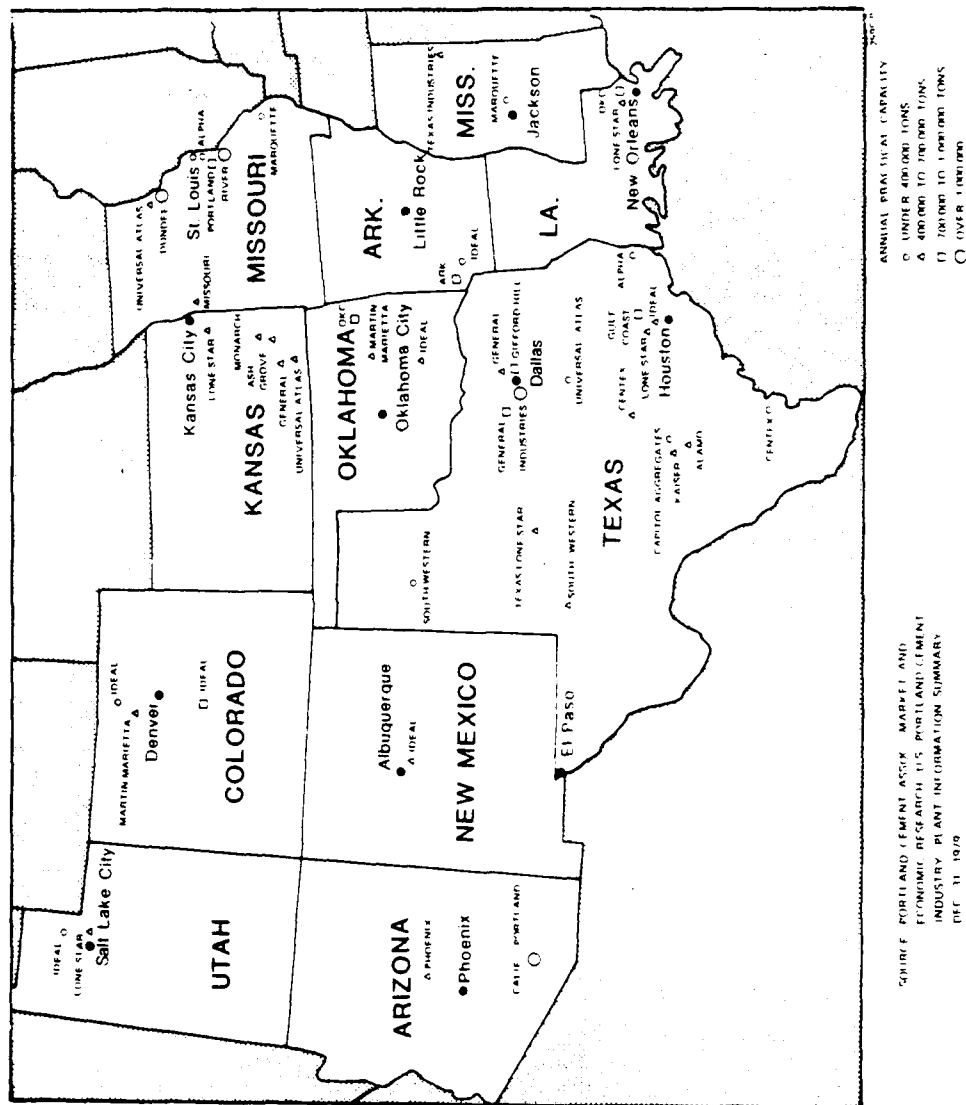


Figure 1.3-2. Locations of cement producing plants in the Texas/New Mexico market area.

Planned capacity changes during 1980 would increase cement capacity by 2,269,000 tons. Two new plants in Texas should provide an additional 1,425,000 tons of capacity. With an expansion of the Marguette plant in Cape Girardeau, capacity in Missouri should increase by 729,000 tons. Also, an expansion in Colorado of 115,000 tons is expected in 1980 (see Table 1.3-8).

The only capacity change announced for 1981 will occur in Texas with the addition of a new 575,000-ton plant.

Capacity expansions planned in 1982 include two new plants in Utah with a combined capacity of 1,150,000 tons and one new plant in Texas with a capacity of 1 million tons.

The Ideal plant in Utah has announced plans to expand its capacity by 580,000 tons, but the projected operational date is unknown.

Overall, Kansas plants have had the highest capacity utilization of 87.2 percent. The six-year average set forth in Table 1.3-9 also indicates that plants in Missouri have a high utilization, where production is the highest in the nation, has averaged 79.1 percent from 1973 through 1978. The lowest capacity utilization rate of 66.1 percent is found in the plants within the district encompassing the states of Colorado, Arizona, Utah, and New Mexico.

Table 1.3-8. Texas/New Mexico market area announced cement/
clinker capacity changes, as of Dec. 31, 1979.

PLANT NAME	PROJECTED OPERATIONAL DATE	LOCATION	CAPACITY 1,000 TONS		
			EXISTING	PROJECTED	NET DIFFERENCE
Ideal	1980	Boettcher, CO	310	425	115
Marquette General	1980	Cape Girardeau, MO	271	1,000	729
Portland	1980	New Braunfels, TX	New	875	875
Texas Industries	1980	Hunter, TX	New	550	550
Total	1980				2,269
Alamo Cement Co.	1981	San Antonio, TX	New	575	575
Total	1981				575
Lone Star	1982	Georgetown, TX	New	1,000	1,000
Lone Star	1982	Grantsville, UT	New	500	500
Martin Marietta	1982	Leamington, UT	New	650	650
Total	1982				2,150
Ideal	Unknown	Devils Slide, UT	360	940	580
Total					580

4014

Source: Portland Cement Association, Market and Economic Research, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1979.

Table 1.3-9. Portland cement capacity utilization, Texas/
New Mexico market area, 1973-1978.

YEAR	PERCENT					
	LOUISIANA AND MISSISSIPPI	MISSOURI	KANSAS	OKLAHOMA AND ARKANSAS	TEXAS	COLORADO, ARIZONA, UTAH AND NEW MEXICO
1973	79.5	90.4	95.1	80.9	83.9	72.4
1974	64.2	83.4	92.0	78.3	79.2	62.3
1975	50.2	76.1	78.3	64.6	71.1	57.9
1976	70.7	83.8	83.8	75.6	76.5	62.1
1977	77.1	87.3	88.5	80.9	84.3	71.7
1978	79.6	89.4	85.5	80.4	79.3	70.3
Six- Year Average	70.2	85.1	87.2	76.8	79.1	66.1

4015

Source: U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook.

2.0 PRICE IMPACTS ON CEMENT ASSOCIATED WITH THE CONSTRUCTION OF THE M-X SYSTEM

This section sets forth forecasts of the production, and consumption of portland cement for the previously defined Nevada/Utah and Texas/New Mexico market areas from 1980 through 1989. Inherent in any forecast is a margin of error, though this margin generally increases as the forecasting period increases. Therefore, these forecasts should serve only as a general indication of future values of production, consumption, and prices.

2.1 FORECASTING TECHNIQUE AND PREDICTIVE MODEL

The technique employed in this section is that of ordinary least-square regressions utilizing several variables. Independent variables were plotted with respect to the dependent variables in order to determine the nature of the association between the independent and dependent variables.

After numerous regressions stipulating various independent variables, three independent or predetermined variables were selected: (1) the real gross national product (GNP) (real in this sense represents constant 1972 dollars), (2) a fuel index, and (3) time.

The selection of the real gross national product was based on its correlation with the real value of construction contracts in each of the market areas. The very strong association between the real value of construction and the consumption of cement, as previously discussed, serves as a predictor of consumption.

As was also discussed earlier, fuel costs represent over one-third of the total manufacturing costs associated with the production of cement. Therefore, a fuel index was included because of the energy intensive nature of the cement industry. The fuel index used in estimating the equations represented an average of the indices reported by the Bureau of Labor Statistics in the "Consumer Price Index" for (1) fuel oil and coal, and (2) gas and electricity.

Time was selected as a nonspecific indicator of movements in the dependent variables. Other variables such as population, wage rates, etc., did not prove as significant as the time variable nor did they add as much to the forecasting ability of the predictive equations.

The consumption and production variables used in the study represented the actual combined production and consumption totals for the states included under each market area. In the same way that production and consumption data was aggregated into a market area total, the value of construction contracts represent an aggregated total for each market area.

The price variable used in this study represented the mill value on a per ton basis in real or 1972 dollars. The price variable was derived by weighing each district's value by its respective shipments thereby arriving at a weighted average mill value for each market area. (Mill value is the actual value of sales to customers, f.o.b. plant; less all discounts and allowances; less all freight charges to customer; less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any; less cost of paper bags and pallets.)

The historical values of the above variables were employed in several regressions covering the 1965 through 1978 time period. The regressions were run in linear, natural log, and semi-log form utilizing different combinations of the variables. Regressions utilizing the linear form of estimation exhibited a better fit with respect to the significance of the coefficients and the R^2 values, which represents the proportion of the variation between the dependent and independent variables.

The general form of the predictive equations and their respective R^2 values for the Nevada/Utah market area as follows:

$$\begin{array}{ll}
 1. & X_1 = a + b\text{GNP} + c\text{Time} & R^2 = .87 \\
 2. & X_2 = d + eX_1 + fX_3 & R^2 = .87 \\
 3. & X_3 = g + hX_4 - X_2 + i\text{Fuel} & R^2 = .84 \\
 4. & X_4 = j + kX_1 + l\text{Fuel} & R^2 = .84
 \end{array}$$

Where: X_1 = value of construction contracts (1972 dollars)

X_2 = consumption

X_3 = mill value per ton (1972 dollars)

X_4 = production

GNP = gross national product (1972 dollars)

Time = time variable

Fuel = fuel index

The operational form of the general equations (1) through (4) are:

$$\begin{array}{ll}
 1. & X_1 = a + b\text{GNP} + c\text{Time} \\
 2. & X_2 = d + ea + eb\text{GNP} + ec\text{Time} + fX_3 \\
 3. & \frac{X_3}{1 + hf} = \frac{g + h(X_4) - hd - hea - heb\text{GNP} - hec\text{Time} + i\text{Fuel}}{1 + hf} \\
 4. & X_4 = j + ka + kb\text{GNP} + kc\text{Time} + l\text{Fuel}
 \end{array}$$

The estimated coefficients for the preceding equations are set forth in Table 2.1-1. The numbers in parentheses represent the "t" statistics. The "t" statistic, computed by dividing the estimated coefficient by its standard error, indicates the significance of the estimated coefficient.

The general form of the estimated equations for the Texas/New Mexico market area and their respective R^2 values are set forth below:

$$\begin{array}{ll}
 X_1 = a + b\text{GNP} + c\text{Time} & R^2 = .93 \\
 X_2 = d + eX_1 + fX_3 & R^2 = .97 \\
 X_3 = g + hX_4 - X_2 + i\text{Fuel} & R^2 = .90 \\
 X_4 = j + kX_1 + l\text{Time} + m\text{Fuel} & R^2 = .89
 \end{array}$$

Table 2.1-1. Nevada/Utah market area
estimated coefficients
and "T" statistics.

ESTIMATED COEFFICIENTS	"T" STATISTICS
-29,390	—
44.815	(3.59) ¹
-820.24	(-1.99) ¹
9,680	—
.56258	(7.59) ¹
-155.238	(-2.62) ¹
15.10	—
-.0029407	(-1.59) ²
.056128	(7.27) ¹
7,561	—
.53568	(5.66) ¹
-8.7476	(1.81) ¹

4016
¹Significantly different from zero
at the 5 percent level of
significance.

²Significantly different from zero
at the 10 percent level of
significance.

Significance computed under a one-
tailed test.

Where: X_1 = value of construction contracts (1972 dollars)
 X_2 = consumption
 X_3 = mill value per ton (1972 dollars)
 X_4 = production
 GNP = gross national product (1972 dollars)
 Time = time variable
 Fuel = fuel index

The operational form of the general equations (1) through (4) are:

1. $X_1 = a + b\text{GNP} + c\text{Time}$
2. $X_2 = d + ea + eb\text{GNP} + ec\text{Time} + fX_3$
3.
$$\underline{X_3 = \frac{g + h(X_4) - hd - hea - heb\text{GNP} - hec\text{Time} + i\text{Fuel}}{1 + hf}}$$
4. $X_4 = j + ka + kb\text{GNP} + kc\text{Time} + l\text{Time} + m\text{Fuel}$

The operational form of the predictive equations estimated for the Texas/New Mexico market area are the same as those specified for the market area of Nevada/Utah with the exception of the use of the time variable in the Texas/New Mexico production equation.

The estimated coefficients and their respective "t" statistics for the Texas/New Mexico market area are set forth in Table 2.1-2.

The estimated equations for both market areas indicated a strong, highly significant positive correlation between movements in real GNP and the value of construction contracts. The inclusion of the time variable provided additional predictive ability in both of the area's equations although its significance in both areas was not as great as the GNP variable.

Movement in the consumption variable for both market areas was specified as being related to the movement in the real value of construction contracts and the real price of cement. For both the Nevada/Utah and Texas/New Mexico market area, the estimated equations indicated that as the real value of construction contracts increased, so did consumption. The equation also indicated that as the real price of cement increased, consumption or demand would decrease. Both coefficients behaved in a manner consistent with economic theory.

Production was employed as the dependent variable with its changes associated with movement in the real value of construction contracts, the fuel index, and time in only the Texas/New Mexico equation. The specifications of the estimated equation for production resulted from numerous regressions utilizing other variables such as price and consumption. It was felt that the above specification captured the influence of both consumption and price through the use of the construction variable. The use of price as an independent variable resulted in negative estimated coefficients indicating that production and prices operated in an inverse relationship. Although this may be the case given rising prices dampening demand and thereby resulting in a reduction in production, the influence of demand in the equation was chosen to be estimated through the use of the construction variable.

Table 2.1-2. Texas/New Mexico market area
estimated coefficients and
"T" statistics.

ESTIMATED COEFFICIENTS	"T" STATISTICS
-34,484	—
48.335	(4.12) ¹
-683.907	(-1.77) ²
10,526	—
.65094	(13.42) ¹
-131.281	(-1.78) ²
17.884	—
-.00061497	(-2.63) ¹
.040916	(9.96) ¹
13,095	—
.41781	(2.39) ¹
544.66	(2.61) ¹
-25.460	(-2.11) ¹

4017

¹Significantly different from zero
at a 5 percent level of
significance.

²Significantly different from zero
at a 10 percent level of
significance.

Significance computed under a one-
tailed test.

Because of the highly energy intensive nature of the cement industry, the fuel index was included in the production equation. The estimated coefficient for the fuel variable, indicated as fuel costs rise production, would decline under a ceterus paribus assumption. Time was also included in the production equation as a nonspecific indicator of other factors which influence the production of cement only in the Texas/New Mexico equation.

The estimated equation specifying price as the dependent variable employed two explanatory variables: (1) the difference in a market area between production in a particular time period and consumption in the same period, and (2) the fuel index.

The first variable associated with price movements, production less consumption, was employed in the forecast equation under the assumption that if an area's production exceeded the area's consumption, a dampening effect would occur on the price and vice-versa when consumption exceeded production, upward pressure on the price would occur. In the equation employing price as the dependent variable, the estimated coefficient of the production-less-consumption variable proved to be highly significant in the Texas/New Mexico market area and less significant in the Nevada/Utah market area. The estimated coefficient carried a negative sign, thus indicating that when production exceeded consumption the price would fall and when consumption exceeded production the price would rise.

The estimated price equations for the Nevada/Utah and Texas/New Mexico market area have respective Durbin-Watson statistics of 1.760 and 1.541. The Durbin-Watson statistic for the Nevada/Utah market area indicates under a one-tailed test at the 5 percent significance level that there is no autocorrelation in the disturbance or error terms. The Durbin-Watson statistic for the Texas/New Mexico area also indicates zero autocorrelation, but because the statistic roughly equals the upper bounds of the significant limits, there is a possibility of inconclusive evidence relating to any autocorrelation between the disturbance or error terms.

The virtually nonexistent linear relationship between the independent variables, "production less consumption" and fuel, in both price equations indicates that multicollinearity is not a problem.

Historically, the Texas/New Mexico market area is an area in which production exceeds consumption and the Nevada/Utah area is an area where consumption generally exceeds production. It should also be noted that historically the Texas/New Mexico market area has had relatively lower mill value prices than the Nevada/Utah market area.

The inclusion of the fuel index in the price equation is based on the energy intensive nature of the cement industry. Because fuel costs represent a large proportion of the total manufacturing costs of cement, rising fuel costs would result in an upward pressure on cement prices. The estimated coefficient proved to be highly significant and its positive sign indicated that increasing fuel costs would increase the price of cement.

With the general and operational estimated equations set forth above, future values of the exogenous or independent variables were estimated.

The difficulty in projecting the future growth in the gross national product for the next 10 years is apparent. Such long-term forecasts usually have little reliability. Fortunately, the objective is to estimate the impacts associated with the construction of the M-X systems on cement prices, and therefore the projected values of GNP are not as critical given the objective of the study.

Given the recessionary nature of the present economy, short-term forecasts for 1980 estimate a slowdown or decline in the growth of real GNP. Fortune magazine projects a decline in real GNP of 2.0 percent (Fortune, 1980) while others such as the brokerage firm of Goldman-Sachs project an overall growth in real GNP of .7 percent. We have assumed a zero growth rate for real GNP in 1980.

Following a slowdown or recessionary period, real growth for the next year or two exceeds the average long-term growth rate. The faster growth experienced in the recovery period is usually dependent upon the severity of the recession. Given the assumption of a no growth situation in real GNP in 1980 and assuming the current recession lasts only one year, growth in 1981 should be slightly greater than the average growth in real GNP. The historical growth rate in real GNP was 3.2 percent annually from 1970-1979. It is assumed the growth in GNP will be 5.2 percent in 1981 and 3.2 percent from 1982 through 1989.

Although fuel costs have dramatically increased since 1973, the cement industry is continually adjusting to high fuel costs by increasing its use of coal and becoming more efficient in its use of energy. For instance, 6.73 million BTUs were utilized in 1970 in the production of one ton of cement compared to 6.59 and 6.31 in 1975 and 1976, respectively (Portland Cement Association, 1978). Because of the responsiveness of the cement industry to higher fuel costs, the fuel index from 1980 through 1989 has been adjusted in an effort to keep its influence in a more proper perspective to increase at a rate of 8.5 percent per year over the 1979 total of 330.42.

Values for the projected variables are set forth in Table 2.1-3.

Given the projected estimated values for the exogenous or independent variables, forecasts of the real value of construction contracts, production, mill prices, and ultimately consumption can be determined by use of the estimated equations.

It should be kept in mind that the equations employed to forecast the above variables are based on historical relationships. Therefore, the forecasted values are based on the assumptions that the historical structural relationships that have characterized the cement industry in the past will remain the same throughout the 1980-1989 period. Furthermore, the forecasts will exhibit a smoother growth than that which has characterized the past due in part to the smoothed forecasts of the independent variables. Past relationships between the general economy and the cement industry are strong, therefore, movements in the economy will most assuredly affect the cement industry. It is beyond the scope of this study to forecast, with any reasonable degree of accuracy, the exact year to year change in the independent variables. Therefore, it is assumed a smoother growth yields smoother forecast values. Furthermore, the primary concern is with the impact on prices associated with changes in the production-consumption relationship, not absolute levels.

Table 2.1-3. Projections of independent variables, 1980-1989.

YEAR	TIME	REAL GNP (Billions of Dollars)	ADJUSTED FUEL INDEX (1972=100)
1980	16	\$1,431.6	358.51
1981	17	1,506.0	388.98
1982	18	1,554.2	422.04
1983	19	1,604.0	457.92
1984	20	1,655.3	496.84
1985	21	1,708.3	539.07
1986	22	1,762.9	584.89
1987	23	1,819.4	634.61
1988	24	1,877.6	688.55
1989	25	1,937.7	747.07

4018

2.2 PRODUCTION AND CONSUMPTION PROJECTIONS FOR THE NEVADA/UTAH MARKET AREA

The forecasted values of construction contracts, production, consumption, and price for the Nevada/Utah market area are set forth in Table 2.2-1.

As set forth previously in Table 2.2-1, throughout the 1980-1989 period, consumption is estimated to exceed production much the same as it has in the past. The forecasted values suggest that consumption will increase at an annual compounded rate of 3.32 percent, reaching a high in 1989 of approximately 22.3 million tons. It is estimated that production will increase from 16.0 million tons in 1980 to almost 21.0 million tons in 1989. Prices are also forecasted to show a sharp increase, resulting mainly from increasing fuel costs. For instance, the real price in 1978 was \$32.56 per ton while forecasted values reach \$52.66 in 1989. While the increase is substantial (a 62 percent increase in the real price of a commodity over 11 years), it should be recalled that as a result of the energy crisis the real price of cement in the Nevada/Utah market area increased from \$20.93 in 1973 to \$32.56 in 1978, an overall increase of 56 percent in just five years.

2.3 PRODUCTION AND CONSUMPTION PROJECTIONS FOR THE TEXAS/NEW MEXICO MARKET AREA

The forecasted values for the Texas/New Mexico market area are set forth in Table 2.3-1. Consumption is projected to surpass production during the 1980s. This forecast reflects the strong growth in construction that has occurred in the area from 1965-1978 and projects its continuance.

Prices in the Texas/New Mexico area are expected to rise rapidly. In 1978 the real price of cement for the area totaled \$28.13 per ton compared to \$48.63 in 1989, an increase of 73 percent.

2.4 PROJECTIONS OF PRICE IMPACTS

Because the forecasted values are based on the continuation of historical patterns, not much time was spent discussing the forecasts because of their minor importance with respect to the objective. It is accepted that in all probability, these estimates of consumption, production, and construction will not be totally accurate. This is due to the fact that production capacity may vary from its historical patterns as well as growth patterns and demand. Because of the problem of forecasting such variables ten years into the future, a price equation utilizing a relative production-consumption variable was employed. The price equation, as discussed earlier, was specified in order to access differences between production and consumption during a time period and to determine the impact on the price of cement. Therefore, accessing the impact of additional demand on the price of cement through the use of the price equation model is more accurate than trying to establish future values of consumption and production.

Through the use of the price equation model, reasonable estimates resulting from the construction of the M-X system can be provided.

The impacts associated with the construction of the M-X system are based on three M-X locational scenarios and two cement utilization options.

Table 2.2-1. Nevada/Utah market area forecasts 1980-1989.

YEAR	VALUE OF CONSTRUCTION CONTRACTS ¹	(THOUSANDS OF TONS)		MILL VALUE ¹
	(MILLIONS OF DOLLARS)	PRODUCTION	CONSUMPTION	(DOLLARS PER TON)
1980	\$21,643	16,019	16,614	\$33.77
1981	24,157	17,099	17,793	35.28
1982	25,497	17,527	18,297	36.89
1983	26,909	17,970	18,822	38.63
1984	28,387	18,421	19,360	40.52
1985	29,942	18,885	19,916	42.57
1986	31,569	19,355	20,485	44.80
1987	33,281	19,838	21,074	47.21
1988	35,069	20,324	21,675	49.82
1989	36,942	20,815	22,288	52.66

4019

¹Represents real or constant 1972 dollars.

Table 2.3-1. Texas/New Mexico market area forecasts 1980-1989.

YEAR	VALUE OF CONSTRUCTION CONTRACTS ¹	(THOUSANDS OF TONS)		MILL VALUE ¹
	(MILLIONS OF DOLLARS)	PRODUCTIONS	CONSUMPTION	(DOLLARS PER TON)
1980	\$23,770	22,613	22,076	\$29.88
1981	26,682	23,599	23,771	31.41
1982	28,328	23,989	24,645	32.91
1983	30,051	24,341	25,548	34.57
1984	31,847	24,645	26,475	36.40
1985	33,725	24,899	27,435	38.42
1986	35,680	25,094	28,418	40.63
1987	37,727	25,228	29,431	43.06
1988	39,856	25,289	30,468	45.72
1989	42,077	25,271	31,531	48.63

4020

¹Represents real or constant 1972 dollars.

2.4.1 Full Deployment in Nevada/Utah

The first scenario calls for the construction of the M-X system in the Nevada/Utah market area. The second scenario calls for split-basing the system with half the missiles in Utah and Nevada and half in Texas and New Mexico. The third scenario calls for the M-X system to be constructed in Texas/New Mexico.

Table 2.4.1-1 sets forth the impact of constructing the M-X system in Utah and Nevada.

This table suggests that by utilizing the 11 western states as a supply source the impact on the mill value or price of cement would be relatively small.

Under option one, which estimates a total of 2.0 million tons over an eight-year period, the largest impact on cement prices would occur in 1987. Cement prices are estimated to increase by approximately \$1.29 per ton as a result of the Air Force placing an additional demand on the market of 440,000 tons in 1987.

The estimated impact of the M-X system's demand for cement suggests that price increases range from a low of 0.3 percent to a high of 2.8 percent in 1986.

The estimated price impacts associated with the construction of the M-X system under option two, which estimates a total of 1.8 million tons of cement over an eight-year period, are estimated to range from an increase of 11 cents in 1982 to a high of \$1.16 in 1987. In a relative sense, price increases would range from 0.3 percent in 1982 to a high of approximately 2.5 percent in 1986 and 1987.

Estimates suggest that if the complete missile system is constructed in Nevada and Utah and utilizes the 11 western states as a source of supply, the impact on cement prices in any given year would be less than 3 percent.

2.4.2 Full Deployment in Texas/New Mexico

The second scenario calls for the total basing of the M-X system in the eastern New Mexico and western Texas area. Impacts under such a basing proposal result in the estimates set forth in Table 2.4.2-1.

Table 2.4.2-1 suggests that the impacts associated with the construction of M-X in the Texas/New Mexico area would be very minor. The 1987 peak year requirement under option one would result in an estimated 27 cent increase 0.6 percent over the estimated price. Overall impacts ranged from a low of approximately 0.1 percent in 1982 to a high of 0.6 percent in 1986 and 1987.

Impacts under option two suggest a slightly smaller price increase. Price increases resulting from the construction of the M-X system range from a low of about 0.1 percent in 1982 to a high of 0.6 percent in 1986. In absolute terms, the largest impact would occur in 1987 and result in an estimated price increase of 24 cents.

Table 2.4.1-1. Impact on cement prices associated with construction of the M-X system in Nevada/Utah, 1980-1989.

YEAR	FORECASTED PRICE	M-X MISSILE SYSTEM'S DEMAND FOR CEMENT ¹		PRICE IMPACT	
		OPTION 1	OPTION 2	OPTION 1	OPTION 2
	(DOLLARS PER TON)	(THOUSANDS OF TONS)		(DOLLARS PER TON)	
				*	
1980	\$33.77	—	—	—	—
1981	35.28	—	—	—	—
1982	36.89	40	36	\$.12	\$.11
1983	38.63	120	108	.35	.32
1984	40.52	200	180	.59	.53
1985	42.57	260	234	.76	.69
1986	44.80	420	378	1.24	1.11
1987	47.21	440	396	1.29	1.16
1988	49.82	340	306	1.00	.90
1989	52.66	180	162	.53	.48

4021

*Impact prices computed through the use of the Utah/Nevada equation (4).

¹Demand estimates used in preparation of the model differ from estimates used in the EIS. Data in the EIS are more appropriate. Data used in this technical report were not revised since the model rather than the demand data is the critical element and it is appropriate for any demand level.

Table 2.4.2-1. Impact on cement prices associated with construction of the M-X system in Texas/New Mexico 1980-1989.

YEAR	FORECASTED PRICE (Dollars per ton)	DEMAND FOR CEMENT ¹ (Thousands of tons)		PRICE IMPACTS (Dollars per ton)	
		OPTION 1	OPTION 2	OPTION 1	OPTION 2
1980	\$29.88	—	—	—	—
1981	31.41	—	—	—	—
1982	32.91	40	36	\$.02	\$.02
1983	34.57	120	108	.07	.07
1984	36.40	200	180	.12	.11
1985	38.42	260	234	.16	.14
1986	40.63	420	378	.26	.23
1987	43.06	440	396	.27	.24
1988	45.72	340	306	.21	.19
1989	48.63	180	162	.11	.10

4022

¹ Demand estimates used in preparation of the model differ from estimates used in the EIS. Data in the EIS are more appropriate. Data used in this technical report were not revised since the model rather than the demand data is the critical element and it is appropriate for any demand level.

Note: Impact prices computed through the use of the Texas/New Mexico equation (4).

2.4.3 Split Deployment

Table 2.4.3-1 sets forth the estimated impact on cement prices of split-basing the M-X system between Nevada/Utah and Texas/New Mexico. Estimates are provided under both options.

Under option one, impacts within the Nevada/Utah market area are estimated to be approximately one-half of the impacts under a M-X system fully based in Nevada and Utah. Given that the system will be split-based, impacts on prices in the 11 western states will range from a low of six cents per ton in 1982 to a high of 65 cents in 1987. Over the eight year period, the largest relative increase in the Nevada/Utah market area will occur in 1986 when cement prices are estimated to increase by 1.4 percent.

Impacts under option two would be slightly smaller than the above. The largest price impact of 58 cents per ton would occur in the Nevada/Utah area in 1987. In a relative sense, it has been estimated that 1986 would experience the largest price impact of approximately 1.3 percent.

Given the split-basing of the M-X system, it is estimated that the region previously defined as the Texas/New Mexico market area would experience a minimal impact on prices under either option. The largest annual estimated impact on prices would occur in 1987 and result in prices increasing by only 14 cents per ton or 0.3 percent. Under both options, prices under a split-basing proposal are estimated to have a very minor impact on the price of cement in the Texas/New Mexico area, less than 1 percent.

The estimated impact on cement prices under split-basing is subject to purchasing cement from all states comprising the redefined market areas of Texas/New Mexico and Nevada/Utah.

Table 2.4.3-1. Impact on cement prices associated with the split-basing of the M-X system 1980-1989.

YEAR	FORECASTED PRICE (Dollars per ton)		M-X MISSILE SYSTEM'S DEMAND FOR CEMENT IN EACH AREA ¹ (Thousands of tons)		NEVADA/UTAH PRICE IMPACT ² (Dollars per ton)		TEXAS/NEW MEXICO PRICE IMPACT ² (Dollars per ton)	
	UTAH- NEVADA	TEXAS- NEW MEXICO	OPTION 1	OPTION 2	OPTION 1	OPTION 2	OPTION 1	OPTION 2
1980	\$33.77	\$29.88	—	—	—	—	—	—
1981	35.28	31.41	—	—	—	—	—	—
1982	36.89	32.91	20	18	\$.06	\$.05	\$.01	\$.01
1983	38.63	34.57	60	54	.18	.16	.04	.03
1984	40.52	36.40	100	90	.29	.26	.06	.06
1985	42.57	38.42	130	117	.38	.34	.08	.07
1986	44.80	40.63	210	189	.62	.56	.13	.12
1987	47.21	43.06	220	198	.65	.58	.14	.12
1988	49.82	45.72	170	153	.50	.45	.10	.09
1989	52.66	48.63	90	81	.26	.24	.06	.05

4023

¹Demand estimates used in the preparation of the model differ from estimates used in the EIS. Data in the EIS are more appropriate. Data used in this technical report were not revised since the model rather than the demand data is the critical element and it is appropriate for any demand level.

²Impact prices computed through the use of the Utah-Nevada and Texas-New Mexico equations both identified as number (4).

3.0 CONCLUSION

The impacts set forth above for the three scenarios are associated with only the direct requirements of the M-X system. Additional demand for cement will result from the construction of the M-X system. Although the magnitude of such indirect requirements have not been estimated, the price equations can provide estimates with respect to additional cement requirements.

The price equation for the Nevada/Utah market area indicates that for each additional 100,000 tons required by indirect consumers, the price of cement will increase by an estimated 29 cents per ton. An additional demand requirement of 100,000 tons in Texas/New Mexico market area is estimated to increase prices by 6 cents per ton.

The small estimated price impacts associated with the construction of the M-X system under the three scenarios are not unusual when examined in light of current production and capacity (see Table 3-1).

Over an eight year period (1982-1989), the M-X system has been estimated to require a total of either 1.8 million or 2.0 million tons of cement. The peak year requirements under both options would occur in 1987 and result in additional demand requirements of 440,000 tons and 396,000 tons, respectively. To put this into a more proper perspective, the 11 western states in 1978 produced a total of 17,158,000 tons of cement. The 1987, peak year requirement represents at the most 2.6 percent of the total production that occurred in the Nevada/Utah area in 1978 (see Table 3-1). If the split-basing system was utilized, the peak annual requirement for cement would represent no more than 1.3 percent of 1978 total production in the West (see Table 3-2).

When the M-X system demand for cement is contrasted to capacity, the amount of cement required by the system becomes an even smaller proportion. For example, the peak annual amount of cement required for the M-X system under both options represents approximately 2.2 and 2.1 percent of the total capacity of all cement plants in the 11 western states in 1979.

If capacity additions and expansions as set forth in a preceeding section proceed as announced, the western states will have the capacity to increase production as follows: (1) 1980 to 1,349,000 tons; (2) 1981 to 1,000,000 tons; and (3) 1982 to 1,688,000 tons. By 1982, if the announced capacity additions occur, the capacity of the western states will increase by approximately 4,037,000 tons. The 1987 peak year requirement of 440,000 tons associated with the construction of the M-X system represents only 2.0 percent of the 1982 projected capacity of the 11 western states.

With respect to the split-basing of the M-X system, the cement required would represent virtually insignificant amounts when contrasted with the production, capacity and expected capacity of cement plants in the Nevada/Utah market area and the Texas/New Mexico market area (see Table 3-2).

With the M-X system based in Texas and New Mexico, the 1987 peak year requirement under option one represents only 1.9 percent of the total production within the area in 1978. With respect to 1979 capacity, the 1987 peak year requirement accounts for only 1.6 percent (see Table 3-3).

Table 3-1. 1987 peak year requirements as a percentage of production, capacity and expected capacity Nevada/Utah market area.

	THOUSANDS OF TONS	PEAK REQUIREMENTS AS A PERCENTAGE OF	
		OPTION ONE	OPTION TWO
1987 Peak Year Requirements			
Option One	440	—	—
Option Two	396	—	—
1978 Production	17,158	2.6	2.3
1979 Capacity	19,246	2.3	2.1
1982 Expected Capacity	23,283	1.9	1.7

4024

Table 3-2. 1987 peak year requirements as a percentage of production, capacity and expected capacity under split-basing.

	THOUSANDS OF TONS	PEAK REQUIREMENTS AS A PERCENTAGE OF	
		OPTION ONE	OPTION TWO
1987 Peak Year Requirements ¹			
Option One	220	—	—
Option Two	198	—	—
1978 Production In Nevada/Utah Market Area	17,158	1.3	1.2
1978 Production in Texas/New Mexico Market Area	23,566	0.9	0.8
1979 Capacity in Nevada/Utah Market Area	19,246	1.1	1.0
1979 Capacity in Texas/New Mexico Market Area	27,440	0.8	0.7
1982 Expected Capacity in Nevada/ Utah Market Area	23,283	0.9	0.9
1982 Expected Capacity in Texas/ New Mexico Market Area	32,434	0.7	0.6

4025

¹This represents the total requirements of the system divided in half to indicate the impact in each area under split-basing.

Table 3-3. 1987 peak year requirements as a percentage of production, capacity and expected capacity Texas/ New Mexico market area.

	THOUSANDS OF TONS	PEAK REQUIREMENTS AS A PERCENTAGE OF	
		OPTION ONE	OPTION TWO
1987 Peak Year Requirements:			
Option One	440	—	—
Option Two	396	—	—
1978 Production	23,566	1.9	1.7
1979 Capacity	27,440	1.6	1.4
1982 Expected Capacity	32,434	1.4	1.2

4026

If capacity additions and expansions proceed as announced, the Texas/New Mexico market area will have the capacity to increase production as follows: (1) 1980 to 2,269,000 tons; (2) 1981 to 575,000 tons; (3) 1982 to 2,150,000 tons. By 1982, if the announced capacity additions occur, the capacity of the Texas/New Mexico market area will increase by approximately 4,994,000 tons. The 1987 peak year requirement of 440,000 tons represents only 1.4 percent of the 1982 expected capacity of the Texas/New Mexico market area.

Under a supply source comprising the 11 western states, the above estimated impacts appear reasonable. The use of a supply area considerably larger than that which normally characterizes the cement industry would incur substantial costs in transporting cement into the basing area, especially if the M-X system is based in Utah and Nevada.

For example, the transportation cost of shipping cement to Salt Lake City from Denver by rail totals approximately \$1.05 per 100 pounds or about \$21.00 per ton. The transportation costs are significantly higher by truck, costing approximately \$3.43 per hundred weight from Denver to Salt Lake City.

A possible mitigating factor with respect to the high cost that would be associated with transporting cement from all 11 western states involves the examination of planned capacity additions. Nowhere is this element more pertinent than in the state of Utah.

The consumption of cement in Utah has been increasing at an average rate of approximately 4.6 percent per year since 1965. Although consumption has shown a significant increase over the last 14 years, its growth since 1976 has been minor. Consumption in Utah totaled 919,000 tons in 1976, contrasted to 922,000 tons in 1979, representing an increase of only 0.3 percent. Since 1976, consumption in Utah has averaged approximately 910,000 tons per year.

At the present time there are two cement producing plants located in Utah, The Portland Cement Company of Utah, which was recently purchased by Lone Star in Salt Lake City, and Ideal's "Devil's Slide" plant, located in Weber Canyon near Ogden, Utah.

The largest of the two plants is the Lone Star plant with an annual capacity of 420,000 tons of cement. The Devil's Slide plant currently has the capacity of approximately 360,000 tons per year, thereby providing a total capacity for the state of 780,000 tons annually.

Even under a 100 percent capacity utilization rate, Utah must import additional cement in order to meet its demand. Additional cement is usually obtained from the Ideal cement plant in Portland, Colorado although cement from as far away as Seattle and Trident in Montana has been shipped on occasion to meet Utah's demand. At times, cement from Inkom, Idaho serves as a supply source for the northern region of the state.

With Utah consuming approximately 900,000 tons of cement per year (and having the capacity to produce only 780,000 tons), any additional demand of the magnitude of what the M-X system will require would have a significant impact on the availability and price of cement in the state. This, however, is not the expected case. There are plans for the construction of two new cement plants within Utah.

Lone Star is planning to construct a 500,000 ton per year plant in Grantsville in 1982 and Martin Marietta has announced the planned construction of a 650,000 ton per year plant in Leamington, Utah in 1982.

The additions of the two plants will more than double Utah's current capacity from 780,000 tons in 1979 to 1,930,000 tons in 1982. The addition of only one new plant would have the effect of moving the state from a cement importer to a cement exporter. In addition, the Ideal Cement Company is planning to expand their Devil's Slide plant by an additional 580,000 tons per year when demand warrants such an expansion.

It is important to note that the operational date of the two announced expansions would coincide with the proposed start of construction of the M-X system.

Table 3-4 has been prepared under the assumption that the consumption of cement in Utah will continue to grow at the 1965-1979 rate of 4.6 percent per year, which is considerably higher than the growth experienced from 1976 through 1979. Included in Table 3-4 is the projected annual cement requirements associated with the M-X system. The projected capacity does not include the above mentioned expansion at Devil's Slide which would provide an additional 580,000 tons per year.

It appears that if the planned addition of the two cement producing plants in Utah becomes a reality, the impact of the M-X system, even if it obtained its cement from Utah alone would be minimal.

This would be the case even given the substantial quantity of cement required for the construction of the 3,000 megawatt Intermountain Power Plant (IPP). Estimates from the IPP Environmental Impact Statement indicate the IPP will require approximately 240,000 cubic yards for buildings and about 90,000 cubic yards for footing bases for the transmission line towers. Assuming a five bag mix for the buildings and a six bag mix for the transmission lines, the total cement requirements of the IPP would approximate 82,000 tons over the construction period of the project.

The case with Nevada is substantially different, however. In 1979, Nevada consumed approximately 610,000 tons of cement. Consumption within the state has increase dramatically--since 1960 consumption has increased at the average annual compounded rate of 7.4 percent. Currently, only one plant produces cement in Nevada. The plant, located in Fernley, has the capacity to produce 430,000 tons annually and virtually supplies all of northern Nevada with cement. The Fernley plant, with a terminal in Sacramento, also ships to northern California. Cement from northern California also enters the Reno market. Because of the vast distance between Fernley (Reno area) and Las Vegas, southern Nevada is supplied from the southern California area. Although no capacity additions or expansions have been announced for Nevada through 1982, southern and northern California have announced capacity expansions of 2,038,000 and 654,000 tons, respectively.

If the M-X system is constructed in Nevada/Utah, it appears as though the capacity changes projected for California would be able to handle Nevada's increased demand. This would be the case even if the currently discussed power plant in White Pine County is constructed. For example, current estimates indicate

Table 3-4. Consumption and capacity projections
for Utah, 1982-1989.

YEAR	(THOUSANDS OF TONS)			
	CONSUMPTION ¹	CAPACITY ²	SURPLUS CAPACITY	M-X DEMAND FOR CEMENT
1982	1,055	1,930	875	40
1983	1,104	1,930	826	120
1984	1,154	1,930	776	200
1985	1,208	1,930	722	260
1986	1,263	1,930	667	420
1987	1,321	1,930	609	440
1988	1,382	1,930	548	340
1989	1,446	1,930	484	180

4027

¹Assumed to increase at a compounded rate of 4.6 percent
from 1979 total consumption of 922,000 tons.

²Based on announced plans of cement companies and
existing production.

³Demand under the more intensive option 1.

that the Valmy-2 plant planned for construction in Humboldt County during the mid-1980s would require a total of approximately 7,100 tons of cement. Although the Valmy-2 plant is only a 250 megawatt unit, it is unlikely that the power plant planned for White Pine County would require a total demand greater than 14,000 tons.

REFERENCES

"Business Roundup," Fortune, May 19, 1980.

Executive Office of the President, Council on Wage and Price Stability, Prices and Capacity Expansion in the Cement Industry. Staff Report, March 1977.

Portland Cement Association, The U.S. Cement Industry, An Economic Report, March 1978.

Portland Cement Association, Market and Economic Research Department, U.S. Portland Cement Industry: Plant Information Summary, December 31, 1979.

U.S. Department of the Interior, Bureau of Mines, Cement, Mineral Commodity Profiles, MCP-26, November 1978.

*U.S. GOVERNMENT PRINTING OFFICE : 1981 O-723/284

DATE
ILME